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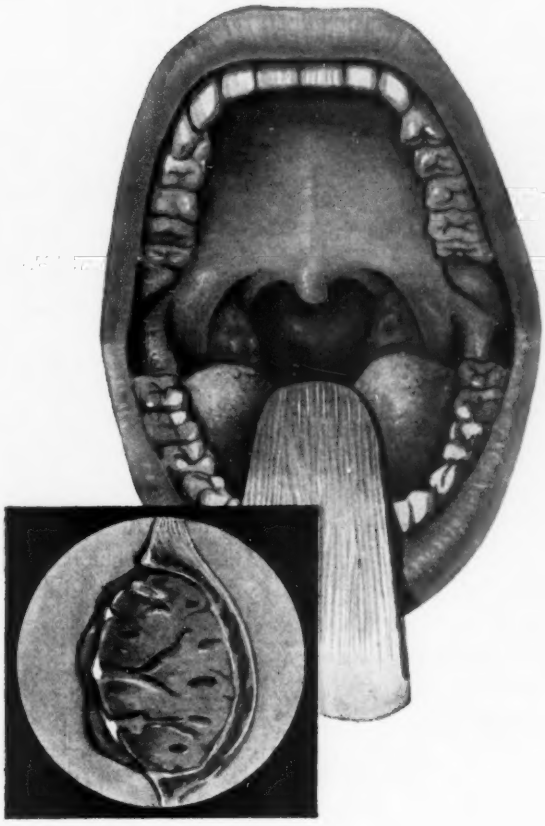

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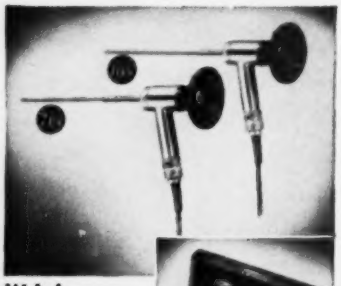

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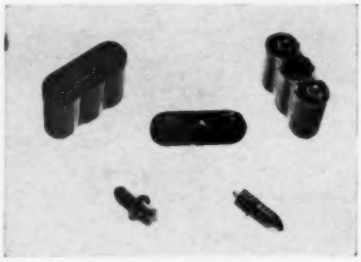

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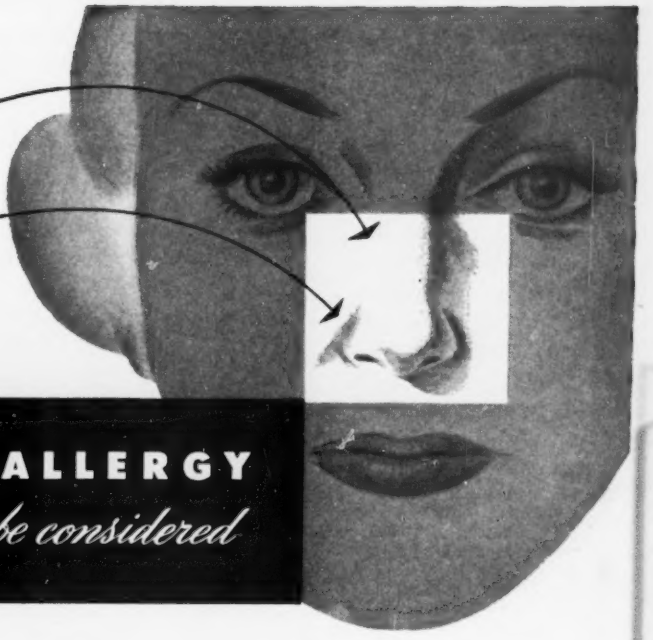

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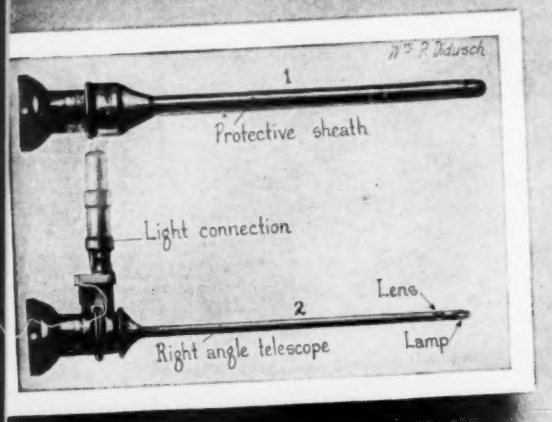

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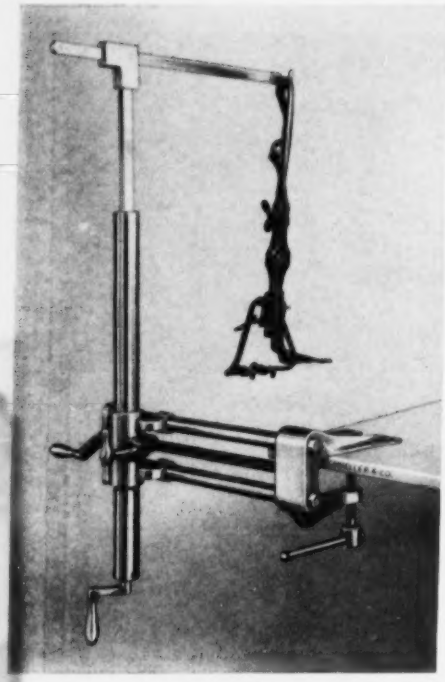

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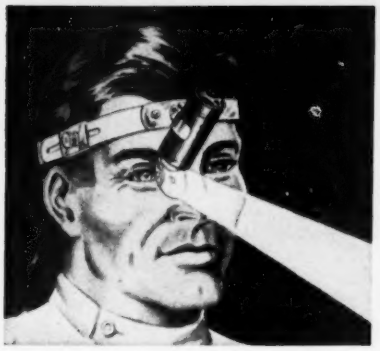

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PRACTICAL ASPECTS OF UNILATERAL AND MODERATE HEARING LOSSES

EVA THOMPSON CARSON, A.B.
CHICAGO

EVERY practicing otolaryngologist sees many patients with either a moderate hearing loss or a hearing loss in only one ear. Though these persons seldom complain of their slight handicap, they are often anxious to know whether or not they might be helped by the use of hearing aids. It is the responsibility of the otolaryngologist to give them advice in regard to suitable auditory rehabilitation.

If the hearing loss is 30 db. or more for the speech frequencies in the better ear, the use of a hearing aid should be recommended. If the loss is less than 30 db. in one or both ears, it is necessary to make a careful appraisal of the patient and his hearing problem before a decision in regard to the use of a hearing aid can be made.

At the Abington (Pa.) Otological Clinic, with which I used to be associated, 9% of the total number of patients seen had unilateral hearing losses. Dr. Walter Hughson, director of this clinic, was totally deafened in his right ear; not only was he deafened, but he had a very loud and annoying tinnitus. Hearing in his left ear was practically normal. One of his most difficult situations was trying to hear conversation while driving a car, for the noise of the motor masked his good ear. Unless the voice of the person on his right was raised, it was necessary for him to turn his head and face the speaker, a dangerous procedure while driving a car. Dr. Hughson wrote an excellent paper entitled "Unilateral Deafness" published in the *Laryngoscope* for September, 1944. The following quotation illustrates his clear understanding of the difficulties encountered by the person with only one serviceable ear. He states:

> In general this disability [unilateral deafness] manifests itself by the greater susceptibility of the single ear to the masking effect of noise; the individual is confused in group conversations and in large gatherings. Speech and sounds on the side of the affected ear may be completely missed.
>
> Compensation can be largely achieved by reasonable alertness in anticipating the direction from which the sound or voice may come or by favorably establishing the position of the intact ear so that it is always directed towards the sound source. A loud tinnitus frequently occurs in the affected ear. This may at times be so intense as to introduce a certain masking effect upon the better ear. Unilateral deafness is not a disability which can be regarded with slight concern.

Hearing-aid users, using only one ear, have the same problem, but their psychological attitude is somewhat different. Neither the average hearing-aid user nor the patient with a hearing loss in one ear has the ability to localize sounds. If spoken to on the side of the deafened ear, he may miss what is said completely or hear it imperfectly, depending on the acoustic situation and the degree of his hearing loss. Men with unilateral hearing losses were seen in the Philadelphia Naval Clinic who had been put in the brig for missing commands or misinterpreting them.

The masking effect of noise is much more of a problem in patients with unilateral hearing loss than it is for the normal or bilaterally deafened person. The confusion of hearing well one minute and poorly the next existent in these patients is little understood or appreciated. Unilateral hearing loss is a definite handicap and should not be minimized.

At a dinner party one night my mother accused my grandmother of flirting with the man on her right saying that she was turned half way around looking up into his face. Grandmother's reply was, "Well you see he was on my deaf ear."

A hearing aid is not the answer to this problem, for bilateral hearing cannot be restored in this way. However, the audiologist sees many a patient who is hopeful that perhaps his problem may be solved by the use of a hearing aid. Experiments were made in the Naval Clinic by using a bone-conduction receiver in an effort to obtain bilateral hearing, but these were unsuccessful, as were the attempts to use an air-conduction receiver in the poorer ear. Even if there is enough residual hearing in the deafened ear to make possible the use of a hearing aid, it is impossible to balance a normal-hearing ear and an aided ear, as is done for the eyes with glasses. The patient will not tolerate the hearing aid but will resort to using his one good ear, adjusting his position as best he can.

Unless the audiologist is aware of the problems presented by these patients, errors are apt to be made in the recommendation of hearing aids. Though little real help can be given these patients, there are a few words of advice they should have. They are as follows:

1. The patient must admit to his friends and family that he has one poor ear. He need not be ashamed of having only one good ear. It is necessary that the speaker be on his good side. With very little thought, situational habit patterns are soon set up.

2. In noisy places, such as restaurants, the patient should choose a seat, if possible, with the good ear nearer a wall, for the wall will act as a sound-reflecting surface for tête-à-tête conversation. In this position the masking effect of the room noise is more annoying to the normal-hearing person than to the person with only one good ear.

3. In movies, theaters, and similar places the patient should seat his companion on the side of his good-hearing ear.

4. A patient with unilateral hearing loss must accept the fact that he cannot use a hearing aid.

Early in the service rehabilitation programs, the audiological consultants for both the Army and the Navy decided that a 30 db. hearing loss in the speech frequencies in the better ear was a handicapping loss. Directives were written stating that any patient with such a loss or a greater loss was to be issued a hearing aid. However, many patients were seen whose average losses in these speech frequencies might be slightly less than 30 db. yet the handicap of the hearing losses just as serious. For example, given an audiogram with a loss of 25 db. for the frequency 512 double vibrations per second and a loss of 30 db. for 1024 and 30 db. for 2048, the average loss for these three speech frequencies would be 28 db. Yet the patient might be having just as much difficulty as the one with an average loss 2 db. greater. These patients with a slight hearing loss are under a greater nervous strain than those with severer losses for many have not yet accepted their handicap and are

still making a real effort to hear. Many patients have extremely annoying head noises, in fact, often it is the tinnitus rather than the relatively insignificant hearing loss that brings the patient to the audiology clinic. Often the use of a hearing aid reduces or eliminates the tinnitus both for these patients and also for the patients with severer hearing losses. This may be purely a psychological effect, for as yet little is known about the causes of and cures for tinnitus. However, it is an accepted fact that the use of anything that relieves the nervous tension caused by head noises is justifiable.

Standard techniques for the selection of hearing aids for these patients with either a slight hearing loss or a one-sided hearing loss with or without tinnitus fall short. The nervous temperament of the individual is the deciding factor in the final decision in regard to the use of a hearing aid. In the Navy patients with these borderline losses were individually appraised and some given the complete rehabilitation program; others merely had emphasis placed on the learning of speech reading. If the patients wished, they were permitted to borrow suitable hearing aids and try them out in many different situations, using this aid for a period of approximately two weeks. At the end of this time a final appraisal was made of the patient's reaction to the use of the aid, and if he wanted one and it was relieving the nervous tension, a hearing aid was recommended. If the reverse were true and the aid merely added to his problems, no aid was recommended.

Because of the psychological aspects involved it is impossible to make the determination as to the recommendation of a hearing aid for these patients by means of standard tests. Each must have an opportunity to try out an aid, and the aid must definitely be suitable, that is, a moderate-gain instrument and not one with too much amplification. The age and desires of the users are the important factors.

CONCLUSIONS

Experience has shown that hearing aids may be of real benefit to persons with only slight hearing losses. It is essential that an intelligent appraisal of the patient and his difficulties be made before the use of a hearing aid is recommended. For psychological reasons the use of a hearing aid by an elderly person with a moderate hearing loss is often contraindicated.

Patients with unilateral hearing losses cannot compensate for their hearing difficulty by the use of hearing aids.

1104 So. Wabash Ave.

HEARING AIDS FOR YOUNG CHILDREN

JACK L. BANGS, Ph.D.
AND
TINA E. BANGS, M.A.
HOUSTON, TEXAS

LOCAL, state, and national hearing conservation programs have caused the loads of speech and hearing clinics to be increased tremendously over the past few years. More and more hard of hearing children between the ages of 18 months and 5 years are being seen, many of whom are also deficient in language capacity. These youngsters are being located earlier than ever before and are brought to the clinics upon the advice of physicians for hearing evaluation, prosthetic selection, and education. Frequently the presence of a communicative hearing loss is merely suspected, and the clinician is confronted with the complicated problem of differential diagnosis. He must evaluate these children carefully and determine whether the lack of communication is due to one or more of the following: low intellectual capacity, emotional maladjustment, lack of motivation or stimulation, brain damage, inadequate maturation, or hearing loss.

This paper will be concerned with the techniques for diagnosis of hearing loss in these children, auditory training, and the steps in the selection of an adequate prosthetic appliance. Space will not allow us to present a complete review of the pertinent literature on these subjects, but they have been dealt with by a number of authors [1] and the reader may refer to their articles for supplementary reading.

TESTING PROCEDURES

Otological examinations are usually required before the children are seen in the hearing outpatient clinics, and detailed case histories and psychometric measures are routine for each child. These measures will not be discussed beyond stating that the findings are considered before a diagnosis is rendered or recommendations are made relative to therapy or prosthesis.

1. (*a*) Bloomer, H.: A Simple Method for Testing the Hearing of Small Children, J. Speech & Hearing Disorders **7**:311-312 (Dec.) 1942. (*b*) Bordley, J. E., and Hardy, W. C.: A Study in Objective Audiometry with the Use of a Psychogalvanometric Response, Ann. Otol. Rhin. & Laryng. **58**:751-759 (Sept.) 1949. (*c*) Davis, H.: Hearing and Deafness: A Guide for Laymen, New York, Rhinehart & Co, Inc., 1949. (*d*) Dix, M. R., and Hallpike, C. S.: The Peep Show, J. Coll. Speech Therapists **12**:5-8 (Sept.) 1948. (*e*) Keaster, J.: A Quantitative Method of Testing the Hearing of Young Children, J. Speech & Hearing Disorders **12**:159-160 (June) 1947. (*f*) Richter, C. P., and Whelen, F. P.: Description of a Skin Galvanometer That Gives a Graphic Record of Activity in the Sympathetic Nervous System, J. Neurosurg. **6**:279-284 (July) 1949. (*g*) Utley, J.: Auditory Training Album Used with the Book What's Its Name? A Guide to Speech and Hearing Development, Urbana, Ill., University of Illinois Press, 1950. (*h*) Whitehurst, M. W.: Train Your Hearing: Lessons for Home Practice, Washington, D. C., Volta Bureau, 1947.

We have found the speech audiometer to be the most valuable instrument for determining the communicative hearing loss of children whether they possess language or not, and during the past few years several techniques have been evolved which have proved to be useful. When a child demonstrates comprehension for language, the procedure consists in having him respond to carefully monitored live voice, delivered at known intensity levels relative to normal hearing, through a high-fidelity amplification system.[2] The child is taken by a clinician into a sound-treated room and shown a series of 10 pictures which are resting on an easel. The pictures used are selected from a group of 50 monosyllabic nouns in picture form which were revealed to be recognized 100% of the time by children 3 years of age.[3] The clinician through a process of play trains the child through the medium of gesture and speech to point to the appropriate pictures upon command.

As soon as the child indicates that he has the idea required of him he is told that he is going to listen through some earphones to a man who will ask him to point to the pictures again. Then the phones are placed on the child, and testing by an examiner sitting in an adjacent control room begins. Frequently no amount of persuasion can get the child to wear the phones, in which event, until recently, a free field test was relied upon for the results. However, it was discovered that most of these children liked the idea of talking on the telephone; so through the courtesy of the local telephone company a French phone was obtained and a PDR-10 receiver mounted in the hand piece. The subjects were delighted with the opportunity to talk over the telephone and responded eagerly to the commands of the examiner. The device is not used unless the children refuse the binaural phones, because there is difficulty in controlling the firmness with which the French phone receiver is held against the ear.

The threshold determined is the intensity level at which the child responds to the instructions of the examiner by correctly selecting all the pictures. Keaster [1e] has suggested the use of a 50% level, but it has been our experience that the child's attention is maintained more easily if the descending technique is used, and the lowest level at which he identifies 100% of the words is considered the threshold. The very young child was found to be more attentive if permitted to hear and make a correct response to the stimulus words. When there were fairly long periods of time with the stimulus below threshold, the child lost interest.

If the child has no language comprehension or usage, adequate testing becomes more difficult and a different technique must be utilized. The number of pictures may be reduced to two or three and care taken to choose pictures, such as house, baby, and shoe, in which the vowel components are quite different. A program of training, using the speech audiometer and the binaural phones, is instituted in which the examiner presents the stimulus at a level loud enough that it is obvious

2. During the process of establishing empirically the intensity value for threshold hearing in children the results indicated that there is an apparent difference between children of various ages so far as their ability to hear speech is concerned. Research done revealed that children between the ages of 3.0 and 4.11 years required, on the average, 6 db. more to reach threshold than did children 4.0 to 5.11 years of age. No attempt has been made as yet to determine why this is true (Fleetwood, K.: Differences in Speech Reception Thresholds of Children at Various Age Levels, unpublished research, University of Washington, 1950).

3. Bangs, T. E.: A Study of Word Lists for Speech Reception Tests, unpublished research, University of Washington, 1949.

from the child's reactions that he is hearing something. As the word is spoken, the assistant takes the child's hand and points with it to the appropriate picture. This is repeated numerous times until the child is conditioned to respond to whatever clues he is getting and finally points to the pictures by himself. We have found that it is possible to train most of these children in this fashion, theorizing that the only clue may well be the vowel sound if the child's loss is in the higher frequencies. It is obvious that these techniques do not give an adequate or accurate threshold but do give the clinician some impression of the extent of the loss involved, though, of course, as with routine speech-reception tests, the results do not give any information relative to the frequency characteristics of that loss.

Obtaining a pure tone audiogram from young children is very difficult in normal circumstances, and the process becomes even more complicated if the child is unable to comprehend instructions because of an extreme hearing loss or lack of language development. The pure-tone audiometric techniques most frequently tried have utilized the conditioned response or some modification of the conditioned response. We have attempted to condition the child in several ways. One technique involves presenting the tone to the child in such a manner that the clinician in the sound-treated room knows when the signal is on and places the fingers of the subject on a telegraph key, which, in turn, lights a small bright red light directly in front of the child. His finger is held on the key and not removed until the tone is interrupted. If the child attempts to light the light, he is stopped until the tone is again presented. This procedure is repeated until the subject responds correctly without assistance, and then the testing begins in the routine manner. However, the reader is reminded that with these children careful searching for threshold during the original testing session will produce fatigue and prejudice attention; so the threshold should be established quickly. It is advisable to start this testing at a frequency of 500 or 250 cps (cycles per second), as these frequencies are more likely to be retained if the child has a congenital perceptive-type loss. Frequent follow-up tests will assist, of course, to determine a more accurate threshold. We have found, however, that the shape of the audiogram is usually fairly accurate even though the threshold may vary considerably.

A similar test involving the same principle of rewards and conditioning may succeed when the technique described above fails. This is the block test, in which the child is trained to move play blocks in or out of a box when he is presented with a pure-tone stimulus. This technique is a practical clinical procedure in that it requires little equipment and is easily administered by only one operator. As with the other test, the results vary with the cooperativeness of the subject.

We have had constructed and are experimenting with a psychogalvanic skin response test, functioning on the same design and principles as the one described by Bordley, Hardy, and Richter.[4] Comments from experience with this equipment cannot be made at this writing except to say that the technical difficulties producing instability of response have been vexatious though there has been success in obtaining objective pure-tone audiograms. Certainly, if the technique can be

4. Bordley, J. E.; Hardy, W. G., and Richter, C. P.: Audiometry with the Use of Galvanic Skin-Resistance Response: A Preliminary Report, Bull. Johns Hopkins Hosp. **82**:569 (May) 1948.

simplified and the instrumentation made more stable, this is the ideal device for securing accurate pure-tone audiograms. Hardy, in a speech presented at the University of Washington, indicated that such testing was routine in his clinic.

As a last resort, when the children are extremely young or are not inclined to cooperate in any way, a startle response may be used as a cue to the general hearing loss. For this testing, side 2 of record No. 1 of the Maico Auditory Training Album exclusive of the voices has proved relatively satisfactory.[15] These sounds are those produced by a train whistle, a vacuum cleaner, a telephone, running water, gun shot, an airplane, an automobile horn, and a piano.

The procedure consists in having the clinician play with the child in the quiet room and keep his attention away from the loud speaker while the operator plays the record and increases the intensity of the sound in 10 db. increments until the child turns toward the sound source. We now feel that this is a very inadequate indication even of the general level of hearing, in spite of the fact that we know the intensity level at which the normal adult ear just detects the sound. This reluctance to consider these levels as meaningful arose out of some experimentation with the Maico records done recently at the University of Washington.

In an attempt to determine something of the frequency characteristics of these noises, a sound-level meter was used to determine the intensity level of the speech audiometer necessary to produce a 50 db. reading on the sound-level meter. Then the intensity level was redetermined with the sound put through an ADC filter system set to allow various frequency bands to be heard. Without reporting the detailed results, it is sufficient to say that in the case of the telephone bell, for instance, when the frequencies between 250 and 500 cps were allowed to pass, it took 29 db. more of intensity to produce the same 50 db. level on the sound-level meter. This implies that the child with a sharp drop in hearing at 500 cps who responds to the unfiltered phone bell sound at 85 db. may actually be hearing it at a loudness level of around 56 db. This is true if we consider his hearing loss to be comparable to the filter system which was employed in the experiment. Further research is obviously needed in this area.

Once the presence of a hearing loss of sufficient extent to interfere with social communication has been established, the parents of such children are interested in remedial measures and inquire relative to them. The possibilities are explained, and they, of course, include a hearing aid and/or an educational program, such as speech reading and auditory training.

Procedures for the selection of a hearing aid for adults have been worked out through various agencies and clinics and are now used routinely. The same is not true when one considers providing a hearing aid for a child who has a marked hearing loss, is in the age range from infancy to 7 years, and may not have useful language. Clinics are also confronted with the fact that in many cases an accurate picture of the extent of the loss is not known and, more frequently, the nature of the loss is not revealed. The first concern then is to accustom the child to amplified sound with a goal toward establishing a true threshold and then fitting the child with an aid. For this reason, a period of auditory training, using a high fidelity amplifier and earphones with good frequency response characteristics, is first initiated.

AUDITORY TRAINING

The program of auditory training is concerned with teaching the youngster to listen to and tolerate gross sounds and ultimately, if possible, to hear the finer discriminations needed for speech. It is through this training process that a child will receive maximum benefit from the use of a hearing aid. We should like to point out that if the correct techniques are used even infants with hearing losses can be taught to attend to sound, and proper amplification at this early age will assist in developing language in a more normal pattern, alleviating in many cases such problems as voice and articulatory disorders common to the hard of hearing person.

There is general agreement in the literature with the steps Carhart presents relative to an auditory training program: "(1) the development of awareness of sound, (2) the development of gross discrimination, (3) the development of broad discrimination among simple speech patterns, and (4) the development of finer discriminations for speech."[5] The following discussion will amplify the first three steps with an aim toward reevaluating the hearing loss and preparing the child for the selection of a hearing aid. The fourth step usually constitutes a long-range program which is carried out once the prosthetic appliance is in use. Specific suggestions for motivational techniques for the preschool child will be included.

We feel that Step 1 is perhaps the most frequently overlooked yet is of prime importance from the point of view of the therapist, whose initial goal is to create in the pupil a desire and a need for listening. Careless techniques, such as frightening the child with the headphones or the initial presentation of too loud a sound, may mean many months lost in the training program. It is imperative, then, that the teacher during the initial meetings with the child have motivational material in an atmosphere that is conducive to the establishment of rapport. This may mean that the clinician is the only one wearing the headphones for the first few sessions or that, perhaps, the introduction of the French phone, as described in the section on testing, will be carried out in the beginning. Once the child has accepted amplification, the following techniques are illustrative of those used for developing the awareness of sound.

The clinician is interested in establishing rapport with the child; so materials appropriate to his interest and age level are selected. For example, Indian dolls and two or three small drums could be assembled on the table in front of the child and he be allowed to play with them. The teacher usually demonstrates how to beat the drum and then invites the child to take his turn. At this point the clinician will don the earphones and indicate with appropriate gestures that she is hearing the sound. The next step then is for the child to listen by means of amplification while the teacher beats the drum and gradually increases the intensity of sound to a point where subjectively she feels the child is hearing at a comfortable level. This step is important, for it will take a long period of training for the child to learn to tolerate the same intensity of sound as is accepted by normal-hearing persons. If the child can be taught early in the auditory training program to adjust the tone control and intensity level of the amplifier, the process of hearing-aid selection will be simplified and better controlled.

5. Davis, H.: Hearing and Deafness; A Guide for Laymen, New York, Rinehart & Co., Inc., 1947, p. 284.

A variety of techniques are initiated to motivate the child to listen to the beating of the drum, and this introduction to sound would probably be sufficient for one lesson. Following sessions would include a review of what had gone before plus the introduction of other instruments and noisemakers, such as horns, cymbals, triangles, whistles, and snappers. When the child is aware that the objects used in the lesson produce a sound and he indicates enjoyment of the sensation by placing the phones on his own ears and adjusting the tone and volume to suit himself, the clinician is ready to proceed to Step 2. The youngster is now ready to learn to discriminate among the various sounds which have previously been presented to him.

In order to teach differences between sounds, two instruments with distinctive qualities of their own, such as a drum and a horn, are given to the child. One technique often used by teachers is to indicate to the child that he is to make a sound with one of the toys while the teacher listens through the phones and hides her eyes. She guesses which noisemaker was used and then offers a turn to the youngster. A reward of some kind, such as receiving a feather in the headdress, is warranted. When the child has learned to discriminate between two sounds, other noisemakers are introduced until he is capable of making a proper selection from among a number of toys. From gross distinction the training will lead to finer tests, such as the difference between windows and doors closing, telephone bells and doorbells, and the pitches of various whistles. When acumen in Step 2 has been achieved, the child is ready to be introduced to picture nouns which are dissimilar in their phonetic make-up, hence more easily distinguished by the child.

The same pictures or objects should be used in this phase of the program as will be utilized in further testing and hearing-aid selection. Games designed to hold the interest of the child are presented in such a manner that the child through amplification alone will learn to select pictures appropriately. When the youngster recognizes through hearing at least three pictures and preferably more, he is ready for another audiometric evaluation and consideration for the use of a hearing aid.

SELECTION OF A HEARING AID

There seems to be some question in the minds of otologists and parents concerning the age levels of children who may benefit from a hearing aid as well as the types of hearing losses that may be assisted. As has been indicated previously in this paper, we are of the opinion that many very young children may be helped by amplification if they are first given an intelligent auditory training program.

When the extent of the loss and the characteristics of the audiogram are considered, there seems to be general agreement among writers that those children with moderate to severe conductive impairments are generally considered suitable candidates for hearing aids. It is not so generally recognized that many children who have perceptive losses with a sharp drop around 1000 cps or only islands of residual hearing may be given material assistance toward communication with amplification accompanied by proper training. The ultimate purpose in hearing-aid selection is to restore or improve the communicative aspects of daily living.

Communication in the broad sense may include far more than mere comprehension through hearing of speech itself. If children can be given the opportunity to receive through the auditory sense gross sounds, such as the warning signal of the automobile horn, the background noises of dinner being prepared or eaten, or even

the vowel sounds of some words, then one is fully justified in searching for proper amplification. In fact, all sound that can be brought to the child through use of a hearing aid will help him to keep in touch with and adjust to his environment. Therefore a prosthetic appliance is warranted if the results of the auditory training program and the second speech reception test indicate that the child will profit in some way from amplification.

The initial procedures for selection of a hearing aid are essentially the same as those in the auditory training program except that the child uses a modern hearing aid instead of the clinical amplifier. One of the hearing aids [6] is arbitrarily selected for his use, and, as with the initial auditory training program, he is allowed to adjust the loudness and tone controls to suit himself. When he has become adjusted to this new method of providing amplification, he is taught to recognize picture words or gross sounds just as he did with the larger amplifier. During these sessions, it is imperative that the clinician keep detailed notes on the responses of the child to the hearing aid. These notes will be a composite of the subjective evaluation of the hearing aid by the clinician and the observed response of the child to the same aid. Work with one aid may continue over a period extending from several days to weeks until the clinician has sufficient information of an objective and subjective nature to feel that that particular aid has had an adequate trial. Then another hearing aid is used in the same circumstances. When a sufficient number of aids have been tried in this manner, the notes made by the clinician are studied and the hearing aids which appeared less suitable are eliminated from further consideration, while those which appear to provide the child with relatively adequate communication are retained for further evaluation.

The last step in the selection of a hearing aid takes place in the sound-treated room. Each instrument is set at a comparable level by having the child listen to conversation while he sets the tone and loudness controls, or, if this is not possible because of inadequate language development, by having him set the aid using the same procedures utilized during the lesson periods. The speech audiometer is now used, and the scores on the tests while using the hearing aids are compared with the scores existing before this program was begun. The smaller the residual hearing loss the more efficient the hearing aid for that child. It frequently appears that several aids provide the child with comparable assistance, in which event the final selection may be one of availability of service for the instrument or some other factor, such as price.

We are of the opinion that this method of hearing-aid selection for children has a twofold advantage: (1) the child begins to use an aid which is known from the onset to be fitted to his needs, and (2) he is prepared to accept and wear the aid. Again we should like to stress that in order for language and communication to develop as normally as possible a hard of hearing child should be fitted with a hearing aid at the earliest feasible age.

SUMMARY

More and more interest has been shown in recent years in the need for methods of testing the hearing of the young child. Subsequent to this interest, there arose a

6. Some speech and hearing centers have been provided with a complete stock of the current models of hearing aids by dealers or other sources.

desire for information on the best methods of evaluating the same child's response to a hearing aid. This paper has been concerned with the diagnostic, educational, and prosthetic problems involved in hearing-aid selection for the young child.

We are aware that hearing conservation begins with early diagnosis and have described methods of conducting such diagnoses. We are further concerned with techniques for the selection of a hearing aid for young children and in preparing them for use of the aid; hence the values of an auditory training program to precede, accompany, and follow the selection of a prosthetic appliance are discussed, and a suggested program is offered. We recommend that procedures similar to those outlined in this paper be initiated just as soon as there is any indication that the child may not hear and that the hearing-aid selection may well take place during the first 18 months of the child's life.

6504 Bertner St.

THRESHOLD OF REFLEX CONTRACTIONS OF MUSCLES OF MIDDLE EAR AND RECRUITMENT OF LOUDNESS

OTTO METZ, M.D.
COPENHAGEN, DENMARK

THE CONTRACTION of the intratympanic muscles brings about a change in the tension of the tympanic membrane and thus in the acoustic resistance or impedance of the ear.[1] This change in impedance may be utilized for examination also of the muscular contraction in ears with normal tympanic membranes—as, for instance, in determination of the threshold value.

PRINCIPLE OF MEASUREMENT OF IMPEDANCE

An acoustic impedance bridge[2] is employed, the principle of which is very simple: measurement of acoustic impedance by comparison. The impedance to be

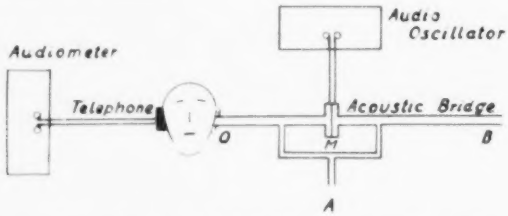

Fig. 1.—Diagram presenting the acoustic bridge and arrangement for examination of changes in the impedance of the tympanic membrane produced by contraction of the intratympanic muscles.

determined—here, that of the ear—is compared (balanced) with a variable acoustic impedance standard.

The bridge (Fig. 1) consists of a tube (O, B), the ends of which are closed by the impedances to be compared. The telephone membrane (M) sounds to either side. When the impedance is the same in two planes lying symmetrically in relation to the telephone membrane, a pressure node will arise at (A) because the two sound waves will reach this place with the same amplitude, though with a phase difference of 180°—due to the movements of the telephone membrane. By means of two auscultation tubes and a Y-shaped glass tube the ears of the examiner are

From the University Ear Clinic, the Rigshospital (Chief: Prof. A. Thornval, M.D.), Copenhagen, Denmark.

1. Metz, O.: Acoustic Impedance Measured on Normal and Pathological Ears, Acta oto-laryng. Supp. 63, 1946, p. 114.

2. Beranek, L.: Acoustic Measurements, New York, John Wiley & Sons, Inc., 1949, p. 336. Schuster, K.: Messungen von akustischen Impedanzen durch Vergleich, Elektr. Nachr. Techn. **13**:164, 1936.

connected with *A* (the detector place), so that he merely has to vary the impedance standard or the comparative resistance until the sound disappears. A change in the tension of the tympanic membrane will upset the balance of the system, and the tone will again be heard. In order to decide whether or not a contraction of the tympanic muscles takes place, the measuring bridge is employed only as a sensitive zero indicator. Thus no calibration is necessary. The extent of the change in impedance can be measured by readjustment of the system. For this a calibration of the variable impedance (the impedance standard) is required.

PROCEDURE FOR EXAMINATION OF MUSCLE REFLEX

The acoustic bridge is applied to one of the patient's ears and balanced by means of the variable acoustic impedance standard as described. Contraction of the intratympanic muscles is elicited by an acoustic stimulus to the contralateral ear. The acoustic stimulus here employed is the tone from the air-conduction receiver of a Western Electric audiometer (Fig. 1).

Thus the muscle contraction is elicited in one ear, and the normally simultaneous muscle contraction in the other ear is used for indicator. Naturally, evaluation of the result is hampered by the circumstance that muscle contraction cannot be

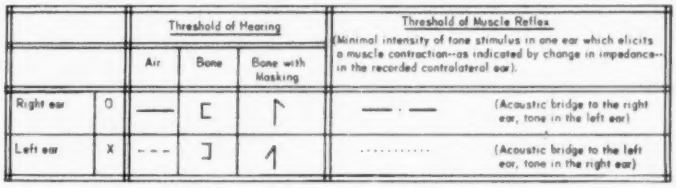
Threshold of Hearing
Air
Bone
Bone with Masking
Threshold of Muscle Reflex
(Minimal intensity of tone stimulus in one ear which elicits a muscle contraction--as indicated by change in impedance--in the recorded contralateral ear).
Right ear
O
Left ear
X
(Acoustic bridge to the right ear, tone in the left ear)
(Acoustic bridge to the left ear, tone in the right ear)

Fig. 2.—Symbols employed in the diagrams, Figures 3, 4, 5, and 6.

determined in the same ear that is exposed to the stimulating sound. Still, this can be done when the movement of the stapedius tendon observed through an ear microscope is used for indicator. But here, where the change in a sound wave reflected from the tympanic membrane is employed as indicator, it would involve considerable technical difficulties if a sound applied to the same ear were to be used as stimulus. On the other hand, with employment of the change in impedance as indicator, the examination may be carried out also on normal tympanic membranes, whereas a perforation of the membrane—or at least of an abnormally pellucid tympanic membrane—is a prerequisite for observation of the stapedius tendon.

Now for each of the frequencies usually employed in audiometry the examiner determines the lowest sound intensity, measured in decibels, that elicits a definite reaction, i. e., a distinctly audible tone at the detector place on the measuring bridge. Then, in the coordinate system usually employed, a threshold value curve may be plotted for the eliciting of the contraction of the intra-aural muscles or, more briefly, the threshold value for the muscle reflex. (As this examination affords no information as to whether the change in impedance is caused by a contraction of the tensor tympani or of the stapedius muscle—or possibly both—I shall here employ the term intra-aural or tympanic muscles.)

The plotting of the curve always indicates to which ear the measuring bridge has been applied. If, for instance, the threshold value curve is plotted for the right

ear, it will show the proprioceptive function of the left and the motor function of the right ear. In normal ears these functions are symmetrical, but in pathological findings, as mentioned, one must estimate closely the results obtained.

THRESHOLD VALUES FOR CONTRACTION OF THE INTRA-AURAL MUSCLES IN NORMAL SUBJECTS

Figure 3 shows two typical curves. Generally the reflex is elicited at an intensity of 70 to 90 db. above the threshold for hearing, most readily at frequencies of about 1,000 to 2,000 d.v. In several normal subjects it proved impracticable to induce a reaction at 128 d.v. and 8,192 d.v., probably because the maximal intensity available at these frequencies was too small.

Such threshold values, of course, will depend upon the sensitivity of the indicator employed. It may be that the threshold is altered a little in the direction of lower intensity by employment of a more sensitive apparatus, but I do not believe that this alteration will amount to very much. This view is based on comparison with the values obtained by observation of the stapedius tendon through an ear micro-

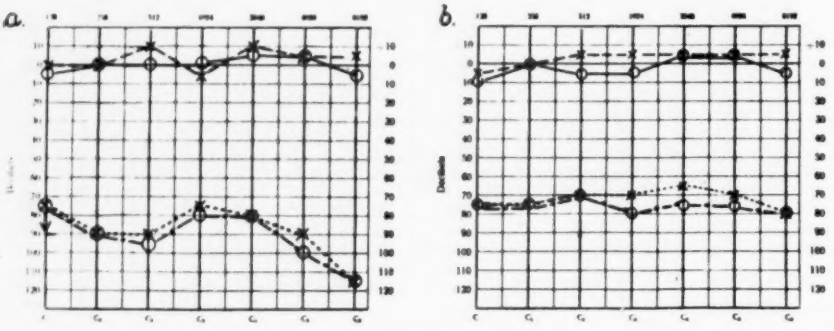

Fig. 3.—Audiograms and thresholds for the reflex contractions of intra-aural muscles in two persons with normal hearing.

scope, as reported by other investigators [3] and found by myself, too, in some cases, and, furthermore, by employment of an oscilloscope as indicator. On examination of the same ear, these different methods give practically the same values.

It is further to be emphasized that it is not the threshold value for the muscle contraction itself that is determined here, but the threshold value for the effect of the muscle contraction on the impedance of the tympanic membrane. The above-mentioned determinations on ears with perforated tympanic membrane and visible stapedius tendon show, however, that no particular difference can be demonstrated.

It is a different matter, though, when the latent period for the change in impedance has to be determined; this will be reported in a subsequent paper, showing it to be somewhat longer than the period for the demonstration of the first contraction of the muscle (in animal experiment) or of the first action current in the stapedius muscle (in man).

3. Hallpike, C. S.: On Function of Tympanic Muscles, J. Laryng. & Otol. **50**:362, 1935. Lindsay, J. R.; Kobrak, H., and Perlman, H. B.: Relation of Stapedius Reflex to Hearing Sensation in Man, Arch. Otolaryng. **23**:671, 1936. Lüscher, E.: Funktion des Musculus stapedius beim Menschen, Ztschr. Hals-Nasen-u. Ohrenh. **23**:105, 1929.

THRESHOLD VALUES IN DEAFNESS FROM IMPAIRMENT OF THE SOUND CONDUCTION

Examination of the muscle reflex is most interesting when the tympanic membranes are normal. It is only to be expected that inflammatory processes in the ear and their sequelae will impair the functional capacity of the intra-aural muscles. Even a simple acute otitis media or catarrhal otitis may give highly different results, varying from normal function of the intra-aural muscles to complete abolition of the function, also with normal hearing. This may become a source of error on examination of ears showing an audiogram of clear-cut perception type.

Even though the present work deals with impairment of the sound perception, it will be appropriate, I believe in passing, to mention the outcome of my investigation into the most significant group of lesions involving the sound conduction in persons with normal or apparently normal tympanic membranes: that of otosclerosis. Gradually a fairly large number of patients with otosclerosis has been examined. In none of the cases in which the affection had advanced so far that diagnosis could be made by means of the usual measures has it been possible to demonstrate any contraction of the intra-aural muscles, even in response to the highest sound intensities.

THRESHOLD VALUES IN PERCEPTION DEAFNESS

In cases of impairment of the sound perception alone the conduction apparatus is found to be intact. Indeed this fact is implied by the definition. Owing to the bilateral innervation, the functional capacity of the muscles—at any rate, in unilateral impairment of the sound perception—may be presumed to be normal. If the threshold values turn out to be abnormal it will be reasonable to ascribe the abnormality to the afferent function. The first persons to be examined in this group of patients with perception deafness presented unilateral impairment of the hearing with normal tympanic membranes and gave a negative past history with regard to inflammatory processes in the ear.

Figure 4 illustrates four cases of unilateral nerve deafness. Here the muscle reflex curves are seen to lie at a normal level and, furthermore, to show exactly the same values for both ears. In particular, the first two patients, who were admitted to the Ear Clinic of the Rigshospital, were submitted to numerous examinations at which first the measuring bridge was applied alternately to the right and to the left ear. I still expected to find the curve for the left ear to be lower than that for the right ear because the sound was applied to the deaf right ear. From the difference in the hearing in the two ears it was reasonable to expect a difference in the curves amounting to 30 to 50 db., but the result for the two ears remained the same. The explanation of this outcome is obvious. As is evident from Figure 4, the sound intensities eliciting a contraction from the ear with normal hearing—and, thus, from the deaf ear too—are associated with complete recruitment of loudness.

Several patients with nerve deafness, bilateral as well as unilateral, have been examined, and some more examples are shown in Figures 5 and 6, with the most probable diagnosis given under each case.

In all these cases the tympanic membranes were found to be normal, and the impedance measurements showed normal sound absorption.

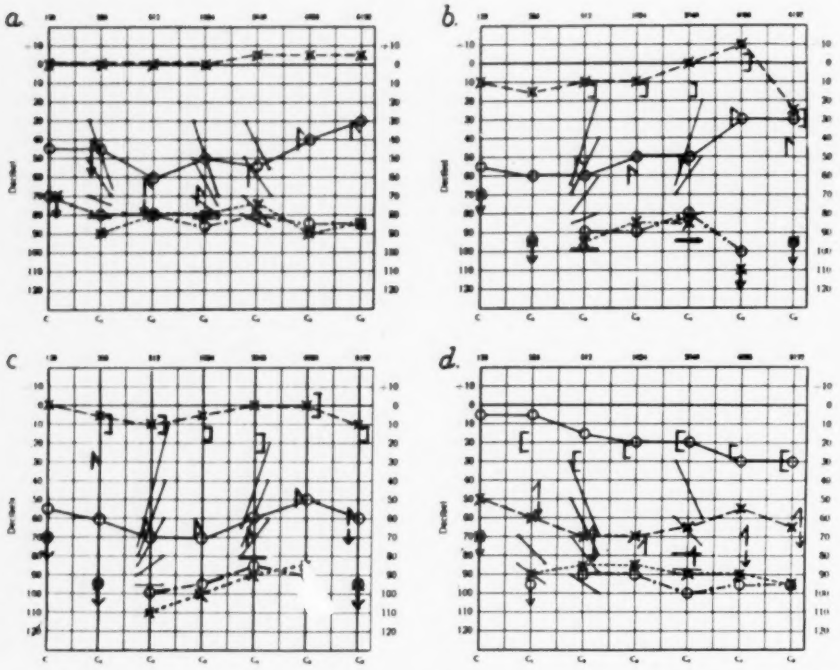

Fig. 4.—Audiograms, binaural balance tests, and thresholds for the intratympanic muscle reflex in four cases of unilateral nerve deafness: *a*, woman, aged *22*: nerve deafness with tinnitus and vertigo (Ménière's disease); *b*, man, aged 30: Ménière's disease?; *c*, man, aged 53: Ménière's disease; *d*, man, aged 30: nerve deafness in the left ear (traumatic?).

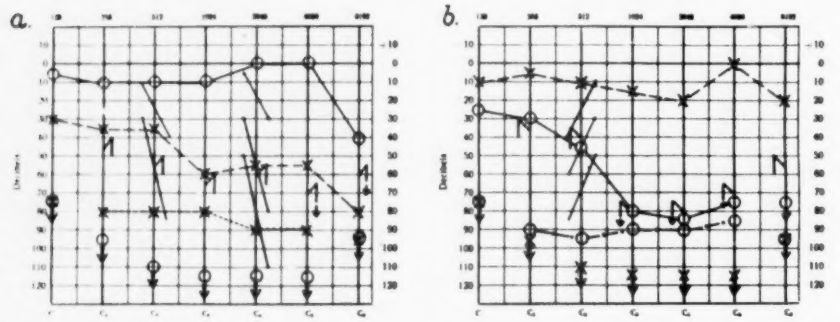

Fig. 5.—Audiograms, binaural balance tests, and thresholds for the intratympanic muscle reflex in two cases of cerebellar pontine angle tumor: *a*, diagnosis verified at operation; *b*, diagnosis verified at autopsy.

The patients with unilateral deafness were examined for recruitment of loudness by means of Fowler's method of the binaural loudness balance. The patients with bilateral deafness were not examined for recruitment of loudness.

The patients with unilateral deafness showed complete agreement between the objectively demonstrated "recruitment," i. e., the unchanged threshold value curve

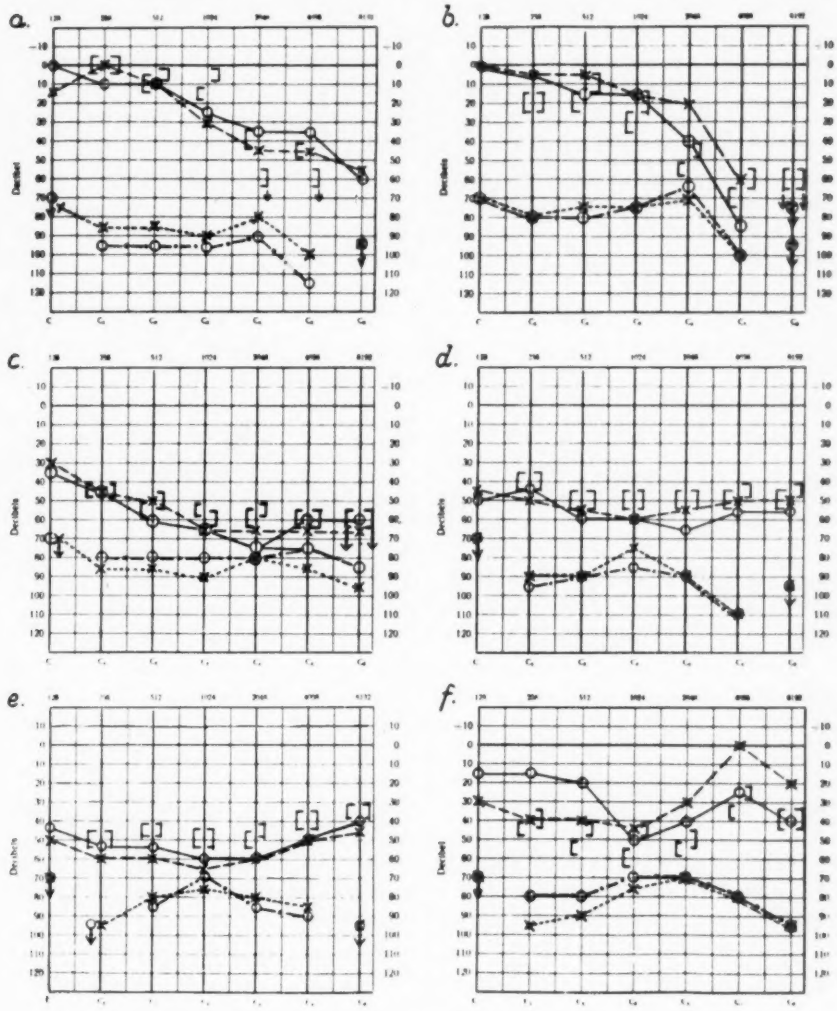

Fig. 6.—Audiograms and thresholds of the intratympanic muscle reflex in six cases of bilateral nerve deafness: *a*, man aged 64 (presbycusis?); *b*, *c*, *d*, hereditary nerve deafness in patients aged *22*, 16, and 14; *e*, *f*, bilateral nerve deafness in two women aged *32* and 44.

for muscle reflex, and the loudness balance test, both in the cases in which the results were positive and in the two cases of neurinoma of the acoustic nerve, in which results were negative.

In all the cases of bilateral deafness the "recruitment" of the threshold values for the muscle reflex was conspicuous oftenest.

The two patients suffering from cerebellar pontine angle tumor further show that the conduction of the sound stimulus from the deaf ear to the ear with normal hearing that naturally must take place does not reach an intensity sufficient to elicit a muscle contraction in the normal ear. The same finding was obtained in several patients with unilateral total deafness.

COMMENT

The recruitment of loudness is a phenomenon that has long been known, but Fowler was the first to adopt it as a diagnostic adjuvant in otology.

In the preceding section a corresponding, objectively demonstrable, phenomenon has been pointed out: that the threshold value for eliciting of contraction of the intra-aural muscles in patients with peripheral nerve deafness is the same as in persons with normal hearing. The present patients with unilateral deafness of this type have also been found to show complete recruitment of loudness at the sound intensity capable of eliciting the muscle reflex. No recruitment of loudness was found in the two cases of verified acoustic neurinoma. Nor was it possible in these two patients to elicit any intra-aural muscle contraction with the sound stimulus applied to the hard-of-hearing ear.

Because of the demonstrated conformity between the recruitment of loudness and the preserved (or altered) threshold values for the muscle reflex, it seems justified to assume that the two phenomena are ascribable to the same pathological changes, presumably in the organ of Corti.

Determination of the threshold value for the muscle reflex can supplement but not replace the Fowler test because the two forms of examination involve different nerve paths and different reactions. In one the sensory impression is estimated by the patient; in the other a motor reaction is estimated by the examiner.

The difficulty in demonstrating the recruitment of loudness, especially in bilateral deafness, is plainly evident from the many different methods advanced for this purpose. In a review of this problem published by Fowler in July, 1950,[4] and entitled "The Recruitment of Loudness Phenomenon," no less than six methods are mentioned for its demonstration. Any otologist who in practice has tried even the simple binaural loudness balance method will have experienced how difficult it often is for the patients to compare the sound intensity in the two ears because the *distortio ad intensitatem* often is associated with a *distortio ad harmoniam*; and for the patient it is even more difficult to compare the intensity of two tones differing in frequency, as he has to do in the monaural loudness balance test.

In determining the threshold values for the muscle reflex the central paths and the cerebral process are excluded, together with the uncertainty and errors implied. On the other hand, I must admit, the efferent path of a reflex arc—two muscles and the conduction apparatus of the middle ear—are introduced with new sources of error, but it seems justified to say that the latter are more easily surveyable. At any rate, it certainly means an advantage that here it is the examiner, not the patient, who has to overcome the difficulties involved.

4. Fowler, E. P.: The Recruitment of Loudness Phenomenon, Laryngoscope **60**:680 (July) 1950.

SUMMARY

A clinically serviceable method is given for determination of the threshold value for the eliciting of contraction of the intra-aural muscles. It is applicable also to normal tympanic membranes, since here the change in the tension of the tympanic membrane (impedance) due to the muscle contraction is used for indicator. This change in impedance is demonstrated by means of an acoustic bridge. The threshold value curve is obtained by plotting the least sound intensity (measured in db.) over the threshold of hearing for the frequencies employed in ordinary audiometry that can produce a change in the impedance of the tympanic membrane.

In normal subjects the reflex is found to be elicited by a sound intensity of 70 to 90 db., most readily by an intensity of 1,000 to 2,000 d.v. In otosclerotic patients this reflex cannot be elicited.

In patients with impairment of hearing assumed to be of peripheral perception type, the threshold value for eliciting of contraction of intra-aural muscles is the same as that of persons with normal hearing.

Examples of cases of bilateral nerve deafness are presented, besides the outcome of the Fowler test and the audiograms from some patients with unilateral nerve deafness. At the intensities capable of eliciting muscle contraction, complete recruitment of loudness is encountered.

In two patients suffering from cerebellar pontine angle tumors (verified) no muscle contraction can be elicited by application of sound stimulus to the deaf ear; nor can any recruitment of loudness be demonstrated in these cases.

Owing to the demonstrated conformity between the recruitment of loudness and the preserved threshold for eliciting of the muscle reflex, each of these phenomena is assumed to be attributable to the same cause, presumably the same pathological changes in the organ of Corti.

OPERATIVE MEDIOFIXATION OF THE VOCAL CORD IN COMPLETE UNILATERAL PARALYSIS

YRJO MEURMAN, M.D.
HELSINKI, FINLAND

AT THE meeting of the Otolaryngological Section of the Swedish Medical Society on March 30, 1942, I demonstrated an operative method for curing hoarseness following complete paralysis of one vocal cord. At that time five patients had been operated on in the hospital, and phonographic records of the voice before and after the operation had been made in most cases. Furthermore, a moving picture in technicolor* of the operation was demonstrated. The same paper was read and some additional cases demonstrated at the meeting of the Finnish Otolaryngological Society in Helsinki, Feb. 20, 1943.

Most of the patients at that time had war injuries of the neck, and consequently indications for an immediate corrective operation were present. However, immediate correction is not advisable in the case of similar lesions due to other causes, as there may be a change in the condition later on. It is noted from the annual report of the Malmöhuslän Hospital at Lund (Sweden) in 1942 that Professor Dohlman has operated on two patients with success according to this method. The method was published in *Archiv für Ohrenheilkunde* in 1944, but with the added experience gained since, chiefly through operations on patients suffering from paralysis after an operation for goiter, the following more extensive account now seems desirable.

This operation is indicated in cases in which the vocal cord of one side has remained paralyzed in a lateral position and the other cord is unable at phonation to reach the edge of the paralyzed one. In these cases the voice is very poor, and often the patient is not able to produce any tone but speaks in a whisper.

Speech with tone is important for everybody, but especially for persons whose occupation requires speaking. The patients operated on by this method obtain a strong sonorous voice which holds on without fatigue.

The position of the vocal cord will be described in this article in the following way: When the cord, movable or immovable, lies in the median line, it is in the "median position." "Paramedian position" indicates that the cord is near the median line but distinctly more lateral. "Close to median line" means that the position is between the median and paramedian lines. The "cadaveric" position is midway between the median and distinctly lateral positions; it may also be termed the intermediate position.

In this paper I am not concerned with the question of the position resulting from injury of the vagus and the recurrent nerve. This question was dealt with in

Paper read at the Assembly of the Collegium Oto-Rhino-Laryngo-logicum, at Brussels, Sept. 10, 1947, and presented in shortened form at the Annual Seminar of the Post-Graduate Medical School of New York University, May 23, 1951.

a study by O. H. Meurman in *Acta oto-laryngologica* in 1951. It is common knowledge that an accidentally paralyzed cord after an operation for goiter in most cases lies in a median or paramedian position. However, occasionally the cord, either immediately or later, assumes a cadaveric (intermediate) or a lateral position which results in a completely aphonic, or at least distinctly hoarse, voice with poor tone. In all the present cases the cord was in the last-mentioned positions.

If the paralyzed cord is in the median or paramedian position, the patient does not require any corrective operation because the sound cord at phonation comes into contact with the paralyzed one. When the paralyzed cord is in the cadaveric position, or more lateral still, either it must be brought operatively into the median line or the sound cord must become able to cross the median line and reach the paralyzed cord in order to produce a satisfactory tone. In some cases this can be accomplished by phoniatric treatment. However, this crossing requires considerable effort and will certainly cause fatigue in persons speaking for a long time. It is questionable whether this treatment is always successful and particularly when the recurrent nerve is ruptured. On the other hand, the voice will be strong and durable when the sound cord does not need to move farther than the median line to reach the immovable cord of the paralyzed side. Therefore, an operative procedure bringing a laterally lying paralyzed cord into the median line is not only justifiable but also in most cases is probably the best solution.

By this method the paralyzed cord is fixed into the median line with costal cartilage. During the war I was occupied with reconstructive and plastic surgery in the field of otolaryngology. In these operations I repeatedly used costal cartilage as supporting material, to my full satisfaction. The cartilage is excised in the following manner: The arch of the ribs is palpated, and usually the point of the 10th or 9th rib is felt separately under the soft covering tissue. It is also possible to appraise the thickness and length of the straight portion. The length must be about 5 to 6 cm. It is advisable to choose a rather straight end. The area in question is anesthetized with procaine hydrochloride; conduction anesthesia is used to the intercostal nerves above and below the corresponding rib in the region of the axillary line, followed by injections under the arch of the ribs in the region of excision and, finally, subcutaneous infiltration. A transverse skin incision is made above the cartilage to be excised. After the subcutaneous fat has been cut through, the fascia of the obliquus externus muscle is divided in the direction of its fibers. The arch of the ribs is found under a rather thin fascia, which is incised along the rib. The cartilage is then excised, together with the perichondrium, either with a knife or with scissors. The dissection is made close to the perichondrium in order to avoid the intercostal vessels. It is often possible to make the whole resection without any ligature. The piece is wrapped in gauze soaked in saline solution. The fasciae, muscles, and adipose layer are carefully sewn with catgut, and the skin is fastened with clamps or sutures.

The laryngeal area can be anesthetized immediately after the anesthetization of the ribs. Epimucous painting of the larynx is not necessary. Conduction anesthesia of the superior laryngeal nerves is recommended. Superficial anesthesia is induced in the median line above the larynx, and a rhomboid area around it is also rendered insensitive.

The skin incision begins slightly above the upper border of the thyroid cartilage, 2.5 cm. lateral to the midline on the side of the sound cord. It traverses the midline transversally, continuing an equal length to the other side and then bending caudally parallel to the sagittal line of the neck and ending slightly below the level of the cricoid cartilage. Thus an angle-formed flap of the skin together with the platysma is dissected from the muscles underneath, and the angle of the thyroid cartilage is laid bare. Along the angle the cartilage is split with caution. Perforation of the mucous membrane in the anterior commissure is to be avoided whenever possible. With a septum elevator a narrow pocket is then made between the perichondrium and the cartilage of the thyroid ala on the inner side approximately on the level of the vocal cord and parallel to its course. The height of the cord cannot be estimated exactly. Generally the anterior commissure is situated somewhat lower than the Adam's apple. The cord runs dorsally but also slightly caudally.

The actual level of the vocal cord is found in the following way: The pocket is slightly enlarged at its posterior end. Its medial wall is now pressed evenly medianward with a straight instrument, e. g., a septum elevator, and the patient is asked to pronounce a word or a long vowel. In this way the level is found at which the voice sounds clearest. It corresponds to the site of the vocal cord.

The pocket is then enlarged but no more than to allow the piece of costal cartilage to be introduced with the thick end first. It is pushed as deep dorsally as possible and must consequently be long enough. Its anterior tip must reach to the split edges of the thyroid alae. The posterior end must be thick enough to dislodge the arytenoid cartilage close to the median line. When of required length, it also turns the arytenoid, which in these cases often is tilted forward, backward closer to the normal position. A slight bend in the rib piece does not matter if care is taken to place the convex side medianward. Consequently, a rib cartilage from the left side is more suitable for the right paralyzed cord, and vice versa. The lower border of the rib usually is thinner than the upper and should therefore be placed downward. The front end of the implanted piece is then attached to the edges of the thyroid cartilages with a piercing catgut suture at the height of the anterior end of the vocal cords. A good fixation of the tip can also be obtained by placing one suture through the edges of the thyroid ala above and another below the point of the implanted piece. Both sternohyoid muscles are sutured to each other over the median line, thus covering the fissure of the thyroid cartilage. The voice mostly sounds clear after the closure. The skin-platysma flap is then stitched into its place with subcutaneous catgut sutures and the edges with silk or clamps.

After the operation some swelling of the corresponding side in the larynx is observed. The voice becomes slightly husky. Often a clear voice returns within a week. Two of the patients had slight dyspnea for just one day after the operation. In one case considerable swelling developed suddenly and necessitated tracheotomy. This swelling was due to infection and will be discussed later. Generally, breathing is entirely free after the operation. After the reaction has passed by, the side operated on, especially the ventricular band, may occasionally remain somewhat plump and prevent the cord from being seen. The dislodged cord is generally in a position close to the median line. Sometimes the vocal process is in a position slightly lateral to the median line. However, the closure of the glottis at phonation is good, and the voice sounds clear. Tension of the paralyzed cord is also improved

by the implanted cartilage, which pushes the arytenoid backward. Simultaneously the faulty position of the arytenoid, viz., the forward tilt, is corrected in some cases.

The total number of patients operated on at present is 15. Five had war injuries of the neck, three had injuries from shell fragments, one from shrapnel, and one from an automatic pistol. Of the civilians, one was wounded with a pistol and one was stabbed with a knife. In two soldiers who were hospitalized because of illness paralysis of one vocal cord developed (Cases 3 and 6). Six patients had previously been operated on elsewhere for goiter, one of them a man. Of the wounded patients, five had injuries of the vagus stem (Cases 1, 4, 5, 9, and 12) and two had injuries of the recurrent nerve (Cases 2 and 7). In two of the former group there were also lesions of several other cranial nerves (Cases 1 and 5) and in two (Cases 1 and 4) there were lesions of the cervical plexus as well; in Case 4 the phrenic nerve was also injured. This last case was remarkable in that the patient was saved by a ligature of the jugular vein and the vertebral artery in a field hospital. Of the two patients with lesions of nontraumatic origin, one (Case 3) probably had a lesion of the recurrent nerve (tuberculous lymphomata) while the other (Case 6) had either a bulbar lesion or a lesion situated centrally in the vagus stem. In the cases of paralysis resulting from an operation for goiter it is difficult to know whether it was due to a lesion of the recurrent nerve alone or whether the superior laryngeal nerve was involved.

REPORT OF CASES

CASE 1.—A. I., a sergeant aged 29, was admitted to the hospital on Oct. 30, 1941. He had been wounded on July 18 by shell fragments in the right side of the neck and the region of the right mastoid. The lesion involved the 9th to the 12th cranial nerves and part of the cervical plexus. Examination showed deviation of the tongue to the right, paralysis of the right soft palate, the right vocal cord in a cadaveric position, and an immobile, dirty-coated wound in the hypopharynx. He was almost aphonic. On November 6 mediofixation of the right vocal cord was performed with a piece of costal cartilage. On November 26 the right vocal cord was close to the median line and slightly concave. On Jan. 1, 1942 the voice was clear (phonogram taken Nov. 20, 1941).

CASE 2.—E. N., a sergeant aged 22, was admitted to the hospital on Nov. 4, 1941. He had been wounded by a shell fragment which pierced the thyroid cartilage. Tracheotomy had been performed, and later decannulation. Examination showed a scar on either side on the anterior border of the sternomastoid muscle, at the level of the thyroid cartilage. The left vocal cord was immobile in the lateral position. The right cord reached the median line on phonation. Above the left vocal cord was a nipple-shaped granulation. The patient was almost aphonic (phonogram taken November 12). On November 14 mediofixation of the left vocal cord was carried out with a piece of costal cartilage 3.5 cm. long. On Jan. 23, 1942, the voice was rather strong and clear. A phonogram was made on January 28. The corrected cord was not quite in a paramedian position, and the patient was sent for phoniatric treatment. He wrote 10 months later that his voice had improved further.

CASE 3.—A. B., a corporal aged 28, was admitted to the hospital on Nov. 11, 1941. In the spring of 1941 he had received x-ray treatment for tuberculous lymphomata of the neck, and hoarseness had developed in August. On examination, the right vocal cord was in a cadaveric position, immobile, and slightly concave. The voice was hoarse. A phonogram was made on November 20. On November 22 mediofixation of the right cord was done with a piece of costal cartilage. On December 10 the corrected cord was almost in a paramedian position. On phonation there was definite contact of cords. A phonogram showed that the voice was clear and strong. A roentgenogram revealed haziness in both hili.

CASE 4.—R. H., a lieutenant whose civilian occupation was director of a deaf-mute institute, was admitted to the hospital on Feb. 6, 1942. He had been wounded by shell fragments in the

left side of the neck. The internal jugular vein and the vertebral artery were ligated at a field hospital. Examination showed rupture of the vagus and phrenic nerves and a lesion of the brachial plexus on the left side. The left vocal cord was in a cadaveric position and immobile. The voice was very hoarse. A phonogram was made on February 7. On February 12, mediofixation of the left vocal cord was done with a piece of costal cartilage. A tiny rent of mucosa in the anterior commissure ensued. On March 3 the voice was rather clear. The corrected cord was close to the paramedian position. A phonogram was taken on May 30. There was good contact of cords on phonation. Eight months later the patient reported that his voice had improved further. He had resumed his civilian occupation. The voice was low but rather clear on Sept. 12, 1951. The patient now speaks with a good, resonant, although not quite clear, voice. He has several lessons each day.

Case 5.—U. K., an army chaplain aged 27, was admitted to the hospital on March 5, 1942. He had been wounded behind the left ear by shrapnel on Nov. 17, 1941. He immediately spat the bullet out. Examination showed a lesion of the 7th, 9th, 10th, 11th, and 12th cranial nerves, total facial paralysis, left soft palate slack, and slight deviation of the tongue to the left. The neck muscles on the left side were slightly atrophic. The left vocal cord was immobile in a cadaveric position. The voice was very hoarse, almost aphonic, and a phonogram was made on March 7, 1942. On March 10 mediofixation of the left vocal cord with a piece of costal cartilage was performed. On March 24 the voice was rather strong but not yet quite clear. On April 17, the left cord was slightly lateral to the median line, and the voice was completely clear in a phonogram. On April 23, corrective facial myoplasty was performed. On October 6 the voice was clear and strong, and the left cord was in a median position. On October 20 a phonogram was taken. By Sept. 23, 1943, the patient had preached and even sung a little in the liturgy. On Jan. 24, 1945, the voice was clear and strong. The condition within the larynx was unchanged.

Case 6.—V. K., a private aged 34, was admitted to the hospital on Jan. 13, 1943. He had been treated at a war hospital from June 16 to Oct. 30, 1942, for polyneuritis. A neurologist later diagnosed encephalitis of the medulla oblongata, near the decussation of the pyramids. Since the end of March the patient had been hoarse. On examination, the left vocal cord was in a cadaveric position and immobile. The whole left side of the larynx was immobile. The right vocal cord moved normally and reached the median line but remained slightly concave. He was aphonic. A phonogram was made on Jan. 20, 1943. On January 22 mediofixation of the left vocal cord was done. A piece of costal cartilage 4 cm. and a second piece 2 cm. in length were inserted into the prepared pocket, the second piece below the first to retain it in position. The superficial wound suppurated. On February 25, a piece of cartilage was expelled. On April 10 the superficial wound was healed. On April the patient was still aphonic. On May 17 he had tone but was hoarse. The left ventricular band and the cord were now midway between cadaveric and paramedian positions and were immobile. The anterior commissure was slightly coated. On June 2, 1945, the voice was resonant but not quite clear, and the left cord was close to the median line and immobile. The left arytenoid showed a slight forward tilt, the left cord being thus somewhat shorter than the right. On respiration, the right cord assumed an extreme lateral position. On phonation it did not reach the median line.

Case 7.—T. M., a private aged 22, whose civilian occupation was farming, was admitted to the hospital on Jan. 1, 1944. He had been accidentally wounded by an automatic pistol in the left side of the neck. Hoarseness set in immediately and did not improve. On admission, he was totally aphonic; the epiglottis was infantile. The vocal cords were pale and somewhat thick. The left cord was slightly concave and shorter, in extreme lateral position, and immobile. On January 26 a phonogram was made. On January 28 mediofixation of the left vocal cord was done with a piece of costal cartilage almost 4 cm. in length. On February 7 both vocal cords were visible; the left cord was slightly injected and thicker. On phonation there was good closure of the cords just to the left of the median line. The voice was resonant though not quite clear. On May 16 a phonogram was taken.

Case 8.—K. I., a sergeant-major aged 31 was admitted to the hospital on March 9, 1945. He had been operated on for goiter on Nov. 24, 1944. His voice changed immediately but he became almost totally aphonic two days after the operation. Treatment with vitamin B_1 resulted in slight improvement of the voice. Since it was not satisfactory, he was readmitted to the hos-

pital. On examination, the mucous membrane of the larynx was of ordinary appearance. The left vocal cord was in intermediate (cadaveric) position, concave, and totally immobile. On phonation the cords were 3 mm. apart. On March 14, 1945, mediofixation of the left vocal cord was done with a piece of costal cartilage. A very tiny rupture of mucous membrane in the anterior commissure ensued. On this spot granulations appeared, which were removed on April 12 and 24, May 8, and June 5 by the aid of a Hasslinger directoscope and suspension laryngoscopy. The left vocal cord was in the median line. By June 2 the voice had cleared up and was strong and clear when a phonogram was taken.

CASE 9.—V. R., a laborer aged 24, was admitted to the hospital on May 23, 1945. On March 2 he had been injured by a pistol shot above the left corner of the mouth. The bullet came out at the back of the neck close to the median line. Suppuration arose in the mouth, in the region of the left tonsil. The suppurating wound in the palate was incised twice. The patient had lost his voice soon after the injury. On examination, the tongue deviated to the left and movements of the left palate were considerably impaired. The epiglottis and the cords were of ordinary appearance. On phonation, the left side of the larynx was immobile. The left cord was in a cadaveric position and immobile. The right cord moved across the median line and almost touched the left cord. The voice was low and husky but slightly resonant on May 28 when a phonogram was taken. On May 30 mediofixation of the left vocal cord was done with a piece of costal cartilage. When the perichondrium was being separated from the left ala, a rupture, about 3 sq. mm. in size, arose in the mucosa in the anterior commissure. The cartilage was fixed to the alae with a piercing suture. On June 1 the patient's slight dyspnea suddenly increased. Emergency tracheotomy was performed. The subcutaneous tissue was swollen and infiltrated. Later the cannula slipped out and had to be replaced. On June 2 the cannula was lengthened with a rubber tube. On June 5 there was abundant secretion of mucus and fever. Swelling and a subcutaneous hematoma in the laryngeal region were noted. Incisions in the neck were performed later, and suppuration lasted about three weeks. On July 10 a piece of cartilage was coughed out through the mouth. In November, examination showed that the left cord had resumed its former cadaveric position.

CASE 10.—O. N., a married woman aged 38, was admitted to the hospital on Feb. 13, 1947. She had always had a clear voice and had no tendency to hoarseness. On Oct. 10, 1946, an operation for goiter had been performed. Immediately after it the voice became somewhat hoarse. It grew gradually hoarser, until it was totally aphonic one month later. On her admission she spoke only in a whisper. There was no swelling of the larynx. The epiglottis, right ventricular band, vocal cord, and arytenoid were of ordinary appearance. The right cord moved normally, and the left cord was in a lateral position and immobile. The left arytenoid tilted forward. The glottis did not close on phonation. On February 12 a phonogram was taken. On February 14 mediofixation of the left vocal cord was done with a piece of costal cartilige, 4.5 cm. long. On February 15 slight dyspnea and swelling of the left arytenoid area were observed. On February 18 swelling had for the most part disappeared, and the left cord was close to the median line. On February 25 the patient spoke with a clear voice. Slight swelling and coating were noted in the front part of the left ventricular band close to the anterior commissure. The left cord was rather close to the median line, and the left arytenoid no longer tilted forward. On phonation there was good closure of the cords. A phonogram was taken on March 20, 1947.

CASE 11.—E. L., a postmistress aged 37, was admitted to the hospital on May 6, 1947. She had been operated on for goiter in 1943. Immediately after the operation her voice was good, but five days later the incision wound began to suppurate, and the voice weakened and became hoarse. On examination the left vocal cord was in lateral position, immobile. The left arytenoid tilted forward. In phonation the right cord reached the median line; in the posterior rima a 2 mm. slit remained. In phonation the left arytenoid was in front of the right. The voice had some tone but was husky (phonogram May 6 and May 7). Mediofixation of the left vocal cord with a piece of costal cartilage was performed. A tiny rent of the mucosa in the anterior commissure arose. On June 9 and July 2 granulation tissue was excised from the anterior commissure. The left cord was close to the median line. In phonation there was good closure of the glottis. The voice was much stronger than before (July 4 phonogram). On Oct. 30, 1950, her voice had become stronger. The left cord was very close to the median line, the arytenoid cartilage was

tilted slightly forward. The glottis closed in phonation. The voice was resonant, fairly strong, somewhat low but entirely feminine.

Case 12.—E. V., a foreman, aged 37, was admitted to the hospital on May 19, 1947. On Dec. 14, 1946, he had been stabbed with a sharp knife through the left maxilla into the neck. The voice became hoarse immediately, and difficulty in swallowing appeared. On admission, the left side of tongue was atrophic, the palate symmetric, and the left cord in cadaveric position, immobile. The tip of the left arytenoid tilted slightly forward. On phonation, a 3 to 4 mm. slit remained in the posterior part of the rima. The voice was totallly aphonic (phonogram May 28). On May 28 mediofixation of the left vocal cord with a piece of costal cartilage, 5 cm. long, was done. On June 5 the voice was almost clear and fairly strong. The left cord was close to the median line. On July 4 the left cord was close to the median position; there was good closure on phonation, and the arytenoids were in almost the same frontal plane. A phonogram showed that voice was completely clear and strong. On Oct. 10, 1947, the voice was fairly strong, resonant, and somewhat low.

Case 13.—L. K., a married woman, was admitted July 12, 1950, suffering from ozena. She had been operated on for goiter Feb. 7, 1950. She had had postoperative fits of coughing and slight dyspnea, and three days after the operation she was hoarse. On admission she was totally aphonic. The right cord was immobile in cadaveric position. The right arytenoid tilted forward and medianward. A small decubitus was seen on the left arytenoid. Only the front half of the right cord was visible. On phonation, a considerable space remained between the cords. A phonogram was taken July 12, 1950. Mediofixation of the right vocal cord with a piece of costal cartilage, 3 cm. long, was performed. On July 13 the right arytenoid was the size of a finger tip. The rima was well open. Very slight dyspnea was present in the afternoon. By July 14 dyspnea had disappeared. On July 20 the right arytenoid was still turned slightly medially but the forward tilt was less than before. Only the hindmost part of the right cord was visible. The voice was resonant, almost entirely clear. A phonogram was taken Oct. 20.

Case 14.—K. S., a married woman, aged 24 was admitted to the hospital on Nov. 6, 1950. She had had an operation for goiter on April 20 of the same year. Immediately after the operation she became hoarse. For one week water "went the wrong way" when she attempted to drink. She coughed frequently but had no dyspnea. The voice did not improve. On admission, the patient was not aphonic but her voice was unpure, somewhat lowered, and weak. The left cord was in cadaveric position, immobile. The left arytenoid tilted slightly forward. On phonation, the cords were about 3 mm. apart. On Nov. 3 a phonogram was taken. On Nov. 7 mediofixation of the left vocal cord with a piece of costal cartilage, 4 cm. long, was performed. The voice cleared up immediately. On Dec. 20 the voice was sonorous and not entirely clear. Speaking was now much easier, and there were no more fits of coughing. The cord was quite close to the median line. The left arytenoid was scarcely turned forward at all. The cords were 1 mm. apart on phonation. On Jan. 27, 1951, a phonogram was taken. On February 17 the voice was clear and strong.

Case 15.—J. M., a married woman, aged 40, was admitted to the hospital on July 11, 1951. She had been operated on for goiter on June 26, 1949, and immediately after the operation became hoarse. On swallowing, she had a strangling sensation. The voice did not improve. On admission, the left vocal cord was in lateral position, markedly concave and immobile. The left arytenoid tilted slightly forward. A space of 3 mm. remained between the cords at the most concave point. The voice was hoarse and not quite aphonic. On July 12 mediofixation of the left vocal cord with a piece of costal cartilage, 3.5 cm. long, was done. On July 23 the voice was somewhat low and husky, but already slightly resonant. The left cord lay close to the median line, and in the posterior part it was slightly concave. Speaking was already much easier. On Sept. 5 the patient was almost aphonic. In the anterior commissure there was a protruding granulation, the size of a pea. It was excised by direct laryngoscopy. Afterward the voice became resonant and rather strong.

COMMENT

Some details of the technique call for consideration. The curved incision goes through the platysma also. Thus a flap is formed by which the split in the thyroid

cartilage is covered at the end of the operation. This mode of closure prevents the "pocket" from being infected through the wound. Moreover, it keeps the implanted piece better in position. It is also possible to make a simple transversal incision through the skin and platysma, but it must be at a lower level and the skin must be retracted upward in order to uncover the thyroid cartilage. When replaced at the end of the operation it covers the split in the thyroid cartilage. Thus the skin incision and the split are not in contact with each other.

As already remarked, injury of the mucous lining in the anterior commissure should be avoided. The mucous membrane here is extremely thin and is easily torn when separated from the thyroid ala. A tiny rupture is not always harmful. Such a rupture occurred in Cases 4, 8, and 11. One of these patients (Case 4) recovered uneventfully. In Case 8 granulation growth in the site of the rent was rather obstinate. It was necessary to remove granulations four times by direct laryngoscopy. However, the final result was excellent: the corrected cord was in the median line and the voice was clear and strong. In Case 11 granulations had to be removed twice. Here, too, the anatomical and functional results were very good.

In Case 9 the rupture was larger. A serious infection arose. Eventually the implanted cartilage was expelled through the larynx. It is, of course, impossible to state with absolute certainty what was the portal of entrance of the infection. However, in such cases bacteria may invade through the ruptured mucosa. This route is generally the most probable. The patient in question had had a rather persistent infection in the mouth shortly before which may have been the real cause of the infection of the implant.

In Case 6 a mild infection occurred. A communication into the lumen of the larynx never developed. Two pieces of cartilage were implanted in the same pocket. It was originally made too wide. To keep the main piece in proper position a smaller one was inserted caudally to it. This was laterally pushed out through the infected wound in the neck. The patient said that he had a tendency to wound suppurations. It should be noted that a noticeable swelling in the interior of the larynx did not develop and tracheotomy was not necessary. Here certainly the infection entered the "pocket" from without. Eventually the result was satisfactory, probably thanks to the fact that the bigger of the implanted pieces stayed in position. As in a number of cases of other corrective operations, I again observed that a piece of implanted costal cartilage can be retained within tissue despite slight infection. This would not be the case with a piece of bone or foreign material.

Excluding one patient (Case 9), slight dyspnea occurred on the first postoperative day in only two cases (Cases 10 and 13), and it disappeared in one day. In each there was a slight swelling in the interior of the larynx, especially in the ventricular band of the same side. The dyspnea never became severe enough to require consideration of tracheotomy. In 12 cases no change in respiration was noticeable. Thus it is obvious that this operation normally does not endanger breathing.

In Case 9 tracheotomy was necessary. Obviously the rather large rent in the mucous lining in the anterior commissure and some virulent strain of bacteria had caused the infection in the operation area. Naturally such a combination is very likely to produce an extensive swelling leading to tracheotomy. But such an occurrence must be very rare if the operation is performed aseptically on patients who do not harbor any infection, and so a tracheotomy will be required only in exceptional cases. This possibility therefore need not deter anyone from using this

method. It is advisable not to enlarge the "pocket" for the implant more than is necessary. The more closely the cartilage is enveloped by tissue, the less is the probability of infection.

As already observed, it is advisable to excise a sufficiently long piece of the costal cartilage, namely 5 to 6 cm. In eight cases I have made notes of the length of the implant. For the four men it varied from 3.5 to 5 cm., being 4 cm. in two cases. For the women the minimum and maximum were 3 and 4.5 cm., respectively. One implant measured 3.5 and one 4 cm. It is, of course, easy to cut off either end if the piece is too long. The anterior end can be cut even after the implantation. The longer the implant, the better the result to be expected.

In cases in which a previous operation for goiter is the etiological factor, there arises the question as to the suitable time of the "corrective" operation. I have performed the mediofixation three and one-half months, four months, five months, seven months, one year, and four years after the thyroid operation. Although spontaneous cure is not usual, it may be advisable to wait about six months. As regards cases due to nontraumatic causes it is difficult to give any definite directions.

Change of Voice After Mediofixation

		After Operation (Number of Cases)							
						Not Quite Clear			
Prior to Operation	Number of Cases	Strong and Clear	Fully Clear	Good and Clear	Almost Clear, Strong	Rather Strong	Resonant	Low	Unchanged
Aphonic	4	1	..	1	..	..	2	..	..
Almost aphonic	3	..	1	..	1	1	..	..	..
Very hoarse	5	3	..	..	..	..	..	1	..
Husky, slightly resonant	3	1	..	1	..	..	..	..	1
Total	15	5	1	2	1	1	2	1	1

Surveying the present material with respect to the anatomical result, I have made the following notes on the position of the cord after the operation. In one case (Case 8) it is in the median line. In seven cases it lies close to the median line (Cases 1, 5, 10, 11, 12, 14, and 15). To this group may be added Case 13, which presents the same features although the exact statement has been omitted from the record. In two cases (3 and 7) the cord was paramedian, and a third (Case 4) may also belong to these on the same basis as the one in the previous group. Somewhat lateral to the paramedian position were the cords in Cases 2 and 6, although in the latter the cord was found later to be close to the median line. In one case (Case 9) in which the implant was later expelled, the cord resumed its preoperative cadaveric position.

More important than the anatomical result is the functional one. Four patients were totally aphonic prior to the operation (Cases 6, 7, 10, and 12), and three (Cases 1, 2, and 13) almost aphonic. Five patients had a very hoarse voice (Cases 3, 4, 5, 8, and 15). All these twelve lacked an adequate voice for verbal communication. The remaining three patients (Cases 9, 11, and 14) had a slightly resonant but husky voice, sufficiently disturbing in conversation. Through mediofixation all the patients, with the exception of one (Case 9) in whom the implant was pushed out, acquired a voice which was not only sufficient in quality for everyday speech but also in most cases strong enough even for some restraint. According to our notes five patients (Cases 3, 5, 8, 12, and 14) had a "strong

and clear" voice, one (Case 1) had a "fully clear," and two (Cases 10 and 11) a "good and clear" voice. Thus, the patient in Case 8 acquired a very clear voice, whereas the voice of five patients was not quite faultless in clarity but the resonance and strength were fully satisfactory.

Many of these patients were observed for a comparatively short period. With time the voice seems to improve further. The clergyman who had a rather good voice, one and a half months after the mediofixation, attained a much stronger voice five months later. However, since he is not able to sing, he has changed his occupation and now teaches in a high school. It is thus to be expected that most of the patients, with time, become more accustomed to the new conditions in the larynx, and their voices gradually improve.

It should be emphasized further that this operation causes no harm to the patient. No muscle is dissected, nor is any motor nerve injured which temporarily might be out of function. It would, in fact, be possible to excise the implanted cartilage again. However, we want to stress the precise indications for this operation. In the traumatic cases it is generally easy to determine whether the lesion is permanent or temporary. In the nontraumatic cases a certain period, not too short, arbitrarily six months, may precede the surgical procedure. During this time the patient may undergo phoniatric training, if desired. If this is of no avail the delay will not affect the benefit to be derived from the operation.

Phoniatric treatment may be tried, of course, in the cases in which one paralyzed cord remains immovable in lateral (cadaveric) position even after a long time has elapsed since the onset of the paralysis. In some of these cases, probably very few, it may lead to positive results. Yet it is scarcely probable that the voice will then attain the same strength as in the cases in which vocal cords have undergone mediofixation. In patients receiving only phoniatric treatment, voice production demands stronger muscular effort and the voice consequently is more liable to fatigue.

SUMMARY

An operative method of restoring the voice after complete paralysis of one vocal cord is presented. It consists of implanting a piece of costal cartilage of the required size between the bulk of the inner laryngeal muscles and the thyroid ala. The cord will thus be brought permanently into a new, more median, in most cases paramedian, position. The voice will be improved, and in the majority of cases it will be very clear. Even persons who must address audiences, e. g., teachers and clergymen, are able to resume their occupations. In this series the cases of 15 patients operated on by this method are discussed. The result has been most satisfactory, with one exception, a case in which the implanted cartilage was expelled because of infection. Phonograph records of the voice before and after operation have been demonstrated on several occasions to the medical profession and have proved the results.

Fredrikinkatu 20A

EFFECT OF CORTISONE ON OSTEOGENESIS FOLLOWING FENESTRATION IN THE MONKEY

An Experimental Study

J. H. T. RAMBO, M.D.
NEW YORK

SEVERAL investigators have noted a delay in the healing of biopsy wounds while patients were being treated with cortisone and corticotropin (ACTH) for various diseases of mæsenchymal tissues.[1] These clinical observations led to investigations to determine the effect of these hormones on the healing of experimental wounds. It was shown that when standard skin defects were made in rabbit ears the effect of cortisone caused a delay in the growth of all elements of connective tissue [2] and retarded the growth of granulation tissue in open wounds.[3] When experimental fractures were made in rabbits, gross healing of the fractures and absorption of the hematomas were greatly delayed in the animals receiving cortisone.[4] Additional studies on the effect of cortisone on induced open wounds in mice [5] as well as incised wounds in rabbits [6] have also shown an inhibitory effect on wound healing. In man the effect of corticotropin on the healing of wounds in two patients was recently described,[7] and an experimental study of the influence

From the Lempert Institute of Otology, Lempert Research Foundation, Inc.

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5. Spain, D. M.; Molumut, N., and Haber, A.: The Effect of Cortisone on the Formation of Granulation Tissue in Mice, abstracted, Am. J. Path. **26**:710-711 (July) 1950.

6. Baxter, H.; Schiller, C.; Whiteside, J. H., and Straith, R. E.: Influence of Cortisone on Wound Healing in Experimental Animals, Plast. & Reconstruct. Surg. **7**:24-31 (Jan.) 1951.

7. Creditor, M. C.; Bevans, M.; Mundy, W. L., and Ragan, C.: Effect of ACTH on Wound Healing in Humans, Proc. Soc. Exper. Biol. & Med. **74**:245-247 (May) 1950.

of corticotropin on healing of incised wounds, skin grafts, and dermatome areas was reported.[8] The earliest of these reports suggested to me, as it has to others,[9] the obvious possibility of systemically suppressing osteogenetic repair at the site of the fenestral rim.

The manner and time of onset of the processes of regeneration and repair of a newly created labyrinthine fenestra in the rhesus monkey were reported by Lempert, Meltzer, Schall, and Wolff.[10] In this series of experiments the usual and approximate sequence of events of connective-tissue repair in the freshly cut bony rim of the fenestra was shown to be, briefly, appearance of fibroblasts on the 3d day, early fibrosis on the 4th day, fibrous tissue filling the fenestra between the 6th and 10th days, islands of regenerating bone in the fenestra on the 14th day, and complete regeneration of bone by the 29th day. It was felt that the parenteral administration of cortisone to similarly fenestrated rhesus monkeys might alter the usual course of events. The freshly cut fenestral rim might heal without osteogenetic closure of the fenestra if cortisone [1a] retarded the early growth of fibroblasts, capillaries, osteoblasts, or other new elements of connective tissue or [1b] arrested at any stage the natural succession of events leading to bony repair.

METHODS

Two healthy Macacus rhesus monkeys were used. Monkey 128-20, weighing 9 lb. 4 oz. (4.2 kg.), was operated on May 23, 1950. Monkey 127-21, weighing 6 lb. 6 oz. (2.9 kg.) was operated on May 25, 1950.

Anesthesia was induced by intravenous injection of pentobarbital sodium.

The operative procedure was the same for the two animals. The right ear was the treated ear. With the postauricular approach the mastoid cells were exenterated and the horizontal semicircular canal exposed. With motor-driven polishing burrs, under microscopic vision, a fenestra was created in the anteriormost portion of the canal near its ampullated end. Under 40 power magnification bone dust and splinters were removed, leaving a fenestra with clean sharp edges. No attempt was made to protect the endolymphatic labyrinth, and the open fenestra was left uncovered to avoid any influence that soft tissue might have on osteogenesis at the fenestral margins. The postauricular incision was closed primarily with buried surgical gut sutures and interrupted black surgical silk skin sutures. During the operation, the animal received a venoclysis of 5% dextrose in distilled water and at the completion of the operation 400,000 units of penicillin intramuscularly.

On the day of operation and daily thereafter for a period of 25 days, each monkey received 10 mg. of cortisone intramuscularly, for a total dose of 250 mg. This dosage of cortisone was considered within the range of that administered to man in relation to respective body weights (proportionately, twice, more or less depending on the size of the two animals, the average daily injection of 100 mg. in the 150 lb. [68 kg.] human). These injections were given for a period of time equal to the approximate time experimentally determined for the usual closure of the fenestra in the untreated rhesus monkey.

Monkey 128-20 was killed 280 days after operation, on March 1, 1951. Monkey 127-21 was killed 278 days after operation, on March 1, 1951. Within 5 to 10 minutes following decapitation, the temporal bones were placed in Heidenhain-Susa fixing solution.

The effect of the medication on the operative lesion was determined by histological examination. A hematoxylin-phloxine stain was used.

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8. Baxter, H.; Schiller, C., and Whiteside, J. H.: The Influence of ACTH on Wound Healing in Man, Plast. & Reconstruct. Surg. **7**:85-99 (Feb.) 1951.

9. Angeluscheff, Z.: Otosclerosis and ACTH: Preliminary Report, A. M. A. Arch. Otolaryng. **54**:200 (Aug.) 1951.

10. Lempert, J.; Meltzer, P. E.; Schall, L. A., and Wolff, D.: Osteogenesis Following Fenestration of the Vestibular Labyrinth of the Rhesus Monkey, Arch. Otolaryng. **46**:512-527 (Oct.) 1947.

Fig. 1 (Monkey 128-20, right ear).—Closure by bone of periosteal origin without invasion of the canal in ear of mature monkey. Note linear space separating capsular bone from regenerated bone.

Fig. 2 (Monkey 127-21, right ear).—Newly regenerated bone of periosteal origin growing into and entirely filling lumen of horizontal semicircular canal in ear of young monkey.

FINDINGS

There was no obvious clinical delay in the healing of the skin edges of the postaural incisions and no evidence of infection in either of the two ears.

Histological findings were as follows: Monkey 128-20: The fenestra in the right ear was completely closed by periosteal bone, although the burnished edges had taken no part in regeneration. There was some hypertrophy of endosteum and regenerating bone within the canal (Fig. 1). Monkey 127-21: The fenestra in the right ear was completely closed as a result of filling in of the lumen of the bony semicircular canal with recently regenerated bone. The regenerating bone had taken origin from healing periosteal bone in the superior portion of the mastoid (Fig. 2).

COMMENT

The ability of corticotropin to delay the growth of connective and osteogenetic tissue has stimulated much interest in the possibility of the use of this hormone in fenestration surgery. As a matter of basic scientific interest, this new biologic approach to the problem of preventing fenestral closure called for investigation. This investigation, determining the effect of cortisone on fenestral closure, was done in the monkey ear, which is most nearly like the human ear. The results described showed complete closure of both fenestrae as a result of new bone growth. In the light of these findings, it may seem academic to speculate on the use of cortisone in the postfenestrated human; yet, it is probably worth while to point out that, even had the results been otherwise, there are difficulties connected with the use of cortisone that must be considered.

Cortisone can be a dangerous drug. It can cause widespread and serious changes in the body. These effects are in general proportional to the amount and duration of its administration. The length of time that cortisone must be used to accomplish the desired end-result then becomes a factor for consideration in the otherwise healthy otosclerotic patient. It has been demonstrated in numerous experiments cited previously that corticotropin and cortisone can delay healing. It has also been shown for incised wounds of skin that following withdrawal of corticotropin after a period of administration up to two weeks, the pattern of wound healing continues unaltered.[8] When given for limited periods, therefore, if cortisone delays healing only temporarily, its use for preventing fenestral closure would hardly be of any permanent value. Another difficulty that would be encountered in the systemic use of cortisone would be its effect on the other surgically injured tissues, which of necessity are a sequal of the fenestration operation. If the drug can delay healing at the site of the fenestra, then it must delay healing of the other injured tissues, since all are subject to the same fundamental physiological processes.

In anticipating the effects of cortisone, it was hoped that the bony labyrinthine capsule, which has the poorest terminal blood supply in the body, might supply the significant factor. If healing could be delayed within the fenestral rim for a period of a few weeks, then after the withdrawal of cortisone the elements leading to osteogenetic repair might not become active again. At the same time, although healing of the other tissues might be delayed, it was also hoped that this delay in the presence of better blood supply would not be so long as to jeopardize the survival of the pedicle flap covering the opened labyrinth.

The difficulty of using a systemically administered agent to inhibit osteogenesis has always been that it could not affect healing of the one tiny area of the fenestral region without at the same time affecting the healing of the other surgically injured tissues or affecting the well-being of the patient as a whole. Cortisone, apparently, is also incapable of accomplishing the desired paradoxical effects, despite the poor blood supply of the labyrinthine capsule. Therefore the systemic use of cortisone in fenestration surgery would, in my opinion, probably create further difficulties without solving the problem of osteogenetic repair.

SUMMARY

The effect of parenterally administered cortisone on osteogenesis following fenestration of the vestibular labyrinth of the rhesus monkey was studied. Two animals were used in the experiment, and a fenestra was made in the horizontal semicircular canal in the right ear of each. An intramuscular injection of 10 mg. of cortisone was given daily to each monkey for a period of 25 days following the operation. The two animals were allowed to live 278 and 280 days postoperatively.

It was observed histologically that the fenestra closed as a result of new bone formation in the fenestrated region in both ears.

119 E. 74th St.

INTRANASAL CHONDROSARCOMA

Report of a Case

LAWRENCE J. LAWSON, M.D.
EVANSTON, ILL.

CHONDROSARCOMA is an uncommon intranasal tumor. In any location it is preeminently a neoplasm found in adults 25 to 50 years of age. It progresses slowly and metastasizes late. Secondary nodules occur in the lungs and are rarely found in other organs. Boyd [1] states that autopsy occasionally reveals continuous intravascular growth of the tumor. Anderson [2] states that this has been known to extend to the right side of the heart or even into the pulmonary arteries.

Solid chondromatous tumors as a class cause concern to pathologists and surgeons because of their known behavior pattern of repeated recurrences. An operation extensive enough to be curative results in repulsive disfigurement, intolerable disability, or both. The knowledge that a very extensive operation is necessary to cure and that a more conservative operation will be followed by slow recurrence encourages many surgeons to shun the very radical operations necessary to eliminate the tumor completely. If a conservative course is adopted, one exposes the patient to the danger of one recurrence after another. The neoplasm may spread beyond the limits of practicable operability, invade the blood vessels, and metastasize to the lungs.

Not infrequently it is difficult to distinguish chondrosarcoma, chondroma, and normal cartilage, especially since all three may be found in the same section. It is proper, then, to consider distinguishing features.

A chondroma [1] is a firm, lobulated, grayish tumor. It arises either from the surface or, as an enchondroma, from the interior of the short bones of the hands and feet, from the ends of the long bones, or from the flat bones—notably from the pelvis, sternum, and scapulae. X-ray study reveals partial or complete destruction of bone. The growth is frequently lobulated and multilocular and has irregular but sharp margins. Microscopically the tumor is composed of atypical cartilage cells having no particular pattern of orientation. Chondroma differs from normal cartilage in that the cells are arranged singly instead of in groups, are nonvascular, are liable to undergo myxomatous degeneration, and often become calcified. In the young the tumor may originate from epiphyseal cartilage. When the bone involved reaches full development the tumor also ceases to grow and becomes calcified or ossified. In the pelvis or sternum the tumor may attain great size and undergo sarcomatous transition. Chondromas are benign in the sense that they grow slowly

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From the Department of Otolaryngology, Northwestern University Medical School, and the Evanston Hospital.

1. Boyd, W.: Textbook of Pathology, Ed. 5, Philadelphia, Lea & Febiger, 1947.
2. Anderson, W. A. D.: Pathology, St. Louis, C. V. Mosby Company, 1948.

and exhibit histologic evidence of a high degree of differentiation. They differ from other benign tumors in that they are capable of local invasion and tend to recur after any operative procedure short of complete excision of the tumor and all adjacent tissues.

A chondrosarcoma usually arises from a previously existing chondroma. It is more frequently found on the surfaces of bones. The transformation is gradual in most instances. It may be easier to determine the change by clinical history and x-ray study than by histologic examination. A large and exceedingly destructive tumor that has spread beyond the bone in which it arose may reveal microscopic features that differ but little from the preexisting tumor. A careful study of many sections will usually reveal evidence of malignant change. The specific evidences of

Fig. 1.—Tumor in nasal space involving the nasal septum and nasal wall of the antrum.

malignancy are (1) poorly formed intercellular matrix; (2) increased cellularity; (3) irregular nuclear patterns; and (4) obvious accelerated growth at the margins of the lobules.

The distinction between chondroma and chondrosarcoma may be difficult, and the pathologist may be influenced by the clinical course, the gross appearance, the tendency to invade, and the evidence of myxomatous degeneration. Lichtenstein and Jaffe[3] state that a cartilage tumor should be regarded as malignant if viable and lightly calcified regions reveal even in scattered fields (1) many cells with plump nuclei, (2) more than occasional cells with two such nuclei, and (3) any giant cell with large single or multiple nuclei or clumps of chromatin.

3. Lichtenstein, L., and Jaffe, H. L.: Chondrosarcoma of Bone, Am. J. Path. **19**:553-589 (July) 1943.

Cartilaginous tumors occur rarely in the larynx. Two such cases were reported by Link.[4]

REPORT OF CASE

History.—Mrs. L. G., aged 76, reported for examination at the Evanston Hospital Sept. 20, 1949. Intranasal examination revealed a high-grade intranasal obstruction, chiefly right-sided, and a purulent right nasal discharge. The nasal septum was crowded to the right, making instrumentation in the right nostril difficult. The patient was diabetic and hypertensive, was afflicted with hypertrophic arthritis of the spine, and had been hospitalized 11 months previously for bleeding duodenal ulcer. Immediate x-ray study of the paranasal sinuses revealed clouding of the right antrum, with extensive destruction of its outer and medial walls. The roentgenologist was uncertain at this examination whether the destruction was operative or due to tumor. There had been no right-sided operative procedure at this time.

Combined therapy consisting of twice-weekly right antrum irrigations, sulfadiazine, and penicillin, produced the change shown in Figure 2.

Fig. 2.—Infection cleared with antibiotics demonstrates the tumor involvement of the infraorbital rim.

Dr. Gordon New, of the Mayo Clinic, gave important supplementary information concerning previous intranasal treatment. The patient came for examination and advice May 4, 1942, with a history of having had 44 x-ray treatments in 57 days for intranasal tumor. At operation, May 7, 1942, a chondroma was removed which completely filled the left nostril, pressed the medial wall of the left antrum, and displaced the nasal septum far to the right. The tumor appeared at the vestibule of the nose anteriorly and was 4 cm. by 5 cm. in size.

On May 31, 1951, the patient was operated on, under diabetic management, at the Evanston Hospital, for excision of tumor of the right nostril and right antrum. The bony portion of the nasal septum was thick and friable. The septum was the apparent site of origin of the intranasal tumor. A portion of the medial wall of the right antrum was replaced by friable tumor tissue. Biting forceps were used for surgical completion of the pathological antrotomy. A

4. Link, M. R.: Chondroma and Chondrosarcoma of the Larynx, Ann. Otol. Rhin. & Laryng. 58:70-85 (March) 1949.

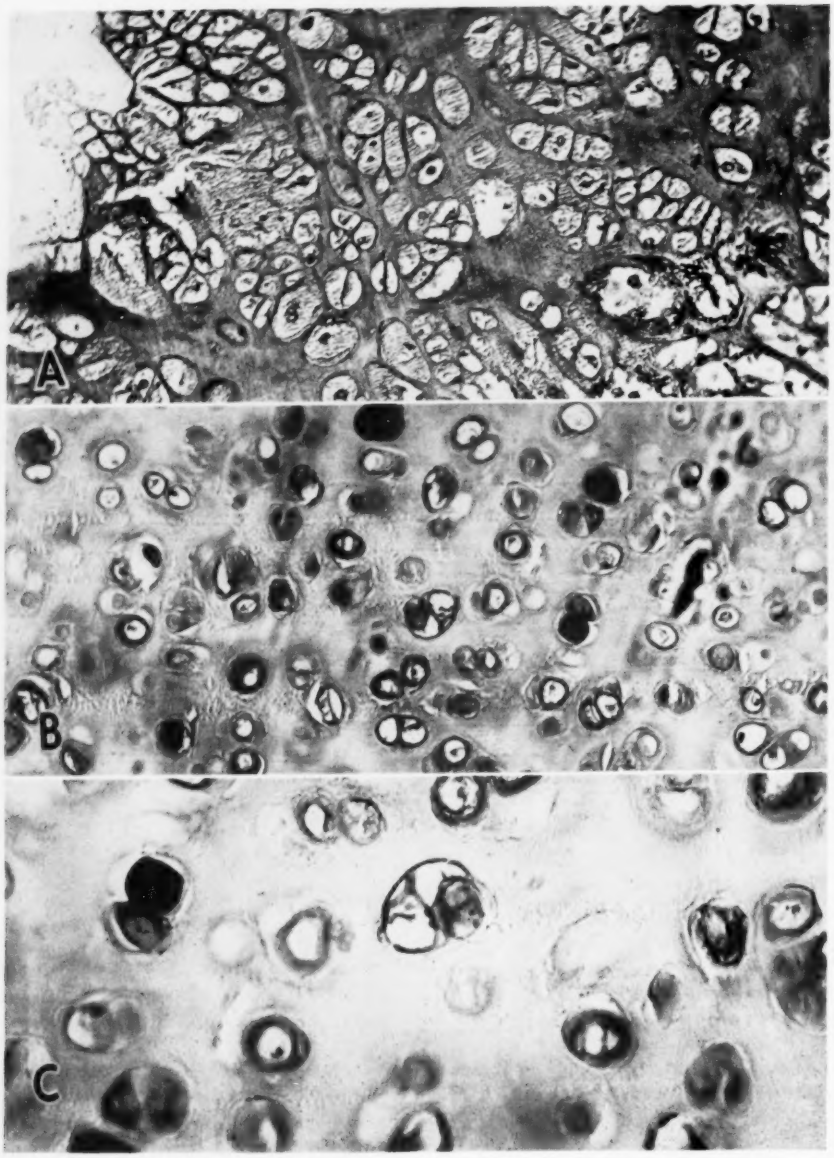


Fig. 3.—*A*, section (× 145) showing pronounced cellular increase; the tumor was diagnosed chondrosarcoma. *B*, section (× 250) revealing increased cells of a scattered type; the tumor was diagnosed as chondroma. *C*, chondroma section under increased magnification (× 475).

curettement of tumor tissue was done as thoroughly as anatomic limits would permit. The tumor tissue encountered was friable, contained cartilage, and was relatively avascular. Although a radical operation had been contemplated, a more conservative operation was done, with removal of all accessible tumor tissue by curettement. This decision was made to allow time for positive identification of the tumor and because an operation sufficiently radical to eliminate every vestige of tumor would have produced a wholly unacceptable cosmetic and functional result.

Microscopic Findings.—The microscopic examination by Dr. J. S. Bracken, of the Evanston Hospital, was reported as follows: "These curettings revealed a tumor composed of immature cartilage cells that show considerable variation in size and shape. These cells are arranged irregularly and reveal abnormal chondrification. The ground substance between the cells is markedly vacuolated. Invasion of neighboring bone trabeculae and bone marrow spaces is noted. In many regions cartilage of normal appearance is seen. A few fragments of respiratory type epithelium overlie the masses of neoplastic tissue. Diagnosis: Chondrosarcoma of the nasal septum and right maxillary sinus."

Fig. 4.—Increased involvement of the infraorbital rim observed in Figure *2*, with interference of ventilation of the frontal sinus.

From June 20, 1950 to July 6, 1950, a period of 16 days, Dr. Anna Hamann, roentgen therapist, Evanston Hospital, gave postoperative roentgen therapy over the right antrum anteriorly and laterally, using two ports, and 12 treatments (size of port 4 by 6 cm., skin dose 3,550 r, and lesion dose 2,485 r.).

The x-ray examination Nov. 10, 1950 revealed no abnormality in the chest. Roentgenograms of the sinuses showed increased thickening of the wall of the right antrum since the previous examination. There had been no further destruction of the bony structure about the right antrum. There was diffuse clouding of the right frontal sinus not present at the last examination. This may have been extension of tumor formation or thickening of the lining membrane from lack of ventilation. All left-sided paranasal sinuses were clear.

The patient at this time was comfortable, with reasonably good nasal ventilation. There were small lobules to be felt on the orbital surface of the right lower orbital rim. These had not increased in size in many months. Surgery sufficiently radical to eliminate this tumor completely would probably not have been possible and certainly not practicable considering the past history of the rate of growth, the patient's age—76 years—and the good social adjustment.

Wirth and Shimkin [5] reported a chondrosarcoma of the nasopharynx with penetration of the cranial cavity, invasion of the antrum, and metastases to the lungs occurring in a 16-year-old boy. Such an involvement in an early period of life presents a most serious problem. The tumor is more active in young persons. The boy lived three years after first examination. The chief features reported were these: There was complete obstruction of the left side of the nose and a painless elevation of the hard palate to the left of the midline for four months. Response to x-ray therapy was inadequate. For 10 months radon was used at semimonthly intervals in 40 gold tubes of 24.5 mc. strength. At the 11th month the mass was firm and shrunken. For five additional months 24 gold tubes of 25 mc. strength were used. The left eye protruded 20 months after it was first seen, and a diagnostic left antrotomy gave a tissue diagnosis of vascular embryonal chondroma. After preliminary tracheotomy and left external carotid artery ligation, a major portion of the mass in the nasopharynx, left antrum, pharyngeal wall, and pterygoid fossa was removed. Thereafter there were repeated tumor removals, and the patient died 36 months after first examination, the total known duration of the illness being 40 months. Microscopic examination revealed highly cellular spindle-cell structure with hyperchromatic nuclei and scanty cytoplasm, with some regions containing cartilage. I have reviewed this report in some detail because it illustrates rather well the different behavior of the tumor at opposite ends of the life span.

Lenz [6] emphasized the well-known dictum that results are best if treatment is early, while tumor tissue is accessible and limited in extent.

Schall,[7] in evaluating surgical approach to tumors of the sinuses, emphasized that the approach depends upon the point of maximum involvement. This might mean exenteration of orbital contents, removal of the orbital floor, or, to provide access to the frontal sinus, exenteration of the ethmoid labyrinth. Ideal removal of cancerous tissue is made through normal tissues with a safe margin. This may be impossible in paranasal sinuses. Here removal may amount to a curettage ideal for disseminating the growth and for local recurrences. For that reason desiccation of the entire operative cavity with a coagulating diathermy current is often advisable. Also, local insertion of radium is advocated to destroy scattered tumor cells. The orbit is protected with a 1 mm. lead shield; the cavity is lined with petrolatum gauze; gauze packing is inserted with radium placed centrally, and 2,000 to 4,000 mg.-hr. exposure given. Many tumors respond to surgery plus coagulation and irradiation with x-rays, radium, or radon. Selection of these therapeutic measures or their logical combination must depend on observation of end-results over a period of years by the rhinologist and the radiation therapist together.

Chondroma and chondrosarcoma are radioresistant; therefore, radiation therapy is disappointing for tumors of cartilage origin.

SUMMARY

Chondroma and chondrosarcoma rarely involve paranasal sinuses and intranasal structures.

5. Wirth, J. E., and Shimkin, M. B.: Chondrosarcoma of Nasopharynx Simulating Juvenile Angiofibroma, Arch. Path. **36**:83-88 (July) 1943.

6. Lenz, M.: Malignant Neoplasms of the Nose, Nasopharynx, and Paranasal Sinuses: Evaluation of Radiation Therapy, Tr. Am. Acad. Ophth. **55**:214-225, (Jan.-Feb.) 1951.

7. Schall, L. A.: Malignant Tumors of the Nose and Nasal Accessory Sinuses, J. A. M. A. **137**:1273-1276 (Aug. 7) 1948.

The intricate anatomy involved usually precludes complete eradication in the sense of eradication with safe margin.

The results of irradiation therapy are still disappointing.

A new case is presented and another reviewed to illustrate the different pattern of behavior likely to be encountered in chondrosarcoma intranasally at the opposite ends of the life span.

Rhinologists confronted with this problem must decide whether circumstances justify conservative treatment, with probable recurrences, or whether they demand radical procedures planned to destroy the tumor completely, thereby risking undesirable functional and cosmetic results.

INFECTIOUS NONDIPHTHERITIC CROUP

JOSEPH G. GILBERT, M.D.
JOSEPH KASNETZ, M.D.
IRA M. ROSENTHAL, M.D.
AND
LAWRENCE MAZZARELLA, M.D.
BROOKLYN

DESPITE recent advances in antibiotic therapy, severe infectious nondiphtheritic croup remains a cause for considerable morbidity and mortality among children. Severe hypoxia still occurs in many children suffering from croup either because proper treatment is not instituted promptly enough or because too much reliance is placed on the use of antibiotic and chemotherapeutic agents alone. Since the report of one of us (J. G. G.) in 1941 of 226 cases of nondiphtheritic infectious croup,[1] a further experience with more than 2,000 cases of croup on our service at Kingston Avenue Hospital has afforded us an ample opportunity for a study of this condition. Special reference will be made in this article to those cases in which in our experience laryngoscopy, bronchoscopy, or tracheotomy is still required and to those factors which in our opinion have led in recent years to an improvement in our results and a reduction of our case fatality rate.

Croup may be defined as a state of obstruction to the entrance of air into the lungs as the result of an inflammatory process in the larynx. The inflammation may extend into the lower respiratory tract. Croup is characterized by inspiratory stridor, hoarseness or aphonia, and a brassy cough. Varying degrees of suprasternal, epigastric, and intercostal retractions, pallor, and cyanosis may be present. In the category of infectious nondiphtheritic croup are included those cases presumably caused by infectious agents other than Corynebacterium diphtheriae. Cases of croup due to allergy, foreign body, chemicals, or other irritative agents are excluded. Henceforth in this article the term "croup" will refer to infectious nondiphtheritic croup.

Many classifications of croup have been proposed.[2] Since the term "croup" covers a symptom complex rather than a single clinical entity, a suitable classifica-

From the Rhino-Laryngological Service of Kingston Avenue Hospital, and the Oto-Laryngological Service of the University of New York, University State Medical Center at New York City, College of Medicine, Services of Dr. J. G. Gilbert.

1. Gilbert, J. G.; Meyersburg, H., and Silverberg, J. S.: Croup: Preliminary Report of One Year's Investigation of 226 Cases, Arch. Otolaryng. **34**:281-296 (Aug.) 1941.

2. (*a*) Gilbert, Meyersburg, and Silverberg.[1] (*b*) Neffson, A. H.: Acute Laryngotracheobronchitis, New York, Grune & Stratton, Inc., 1949. (*c*) Rabe, E. F.: Infectious Croup: I. Etiology, Pediatrics **2**:255-265 (Sept.) 1948. (*d*) Morgan, E. A., and Wishart, D. N. S.: Laryngo-Tracheo-Bronchitis (Statistical Review of 549 Cases), Canad. M. A. J. **56**:8-15 (Jan.) 1947. (*e*) Davison, F. W.: Acute Obstructive Laryngitis in Children, Pennsylvania M. J. **53**:250-253 (March) 1950.

tion should serve as a guide not only for diagnosis but also, if possible, for prognosis and treatment. A careful study has disclosed that many of the proposed classifications are inadequate in this respect because proper cognizance has not been taken of the pathological changes revealed by laryngoscopy, bronchoscopy, and autopsy. The classification of croup (below) proposed by Gilbert and in 1941 was based on these pathological changes. During the past 10 years it has proved most useful to us. Its adoption, in our opinion, would serve to dispel some of the confusion caused by referring to nondiphtheritic infectious croup by such overlapping terms as "pseudomembranous croup," "fibrinous croup," "acute laryngotracheobronchitis," "acute fulminating laryngotracheobronchitis," "Hemophilus influenzae type B croup," "virus croup," "phlegmonous laryngitis," "influenzal laryngitis," "false croup," "spasmodic croup," "catarrhal croup," "membranous croup," and "acute stenotic laryngitis."

Gilbert classifies infectious nondiphtheritic croup thus:

1. Acute catarrhal laryngotracheitis
2. Supraglottic edematous obstructive laryngitis
3. (*a*) Subglottic exudative (or inspissated) obstructive laryngitis and tracheitis
   (*b*) Subglottic edematous obstructive laryngitis and tracheitis
4. Acute obstructive laryngotracheobronchitis

While it is beyond the scope of this article to consider and analyze all the classifications of croup which have been proposed, classifications based on infectious etiological agents have recently attracted attention and merit consideration. In our opinion, such classifications have major weaknesses. They tend to group under single headings cases which present great differences in pathology, symptomatology, and prognosis and cases that call for different types of treatment.

The etiology of croup needs further investigation. Until recently the pathogenic Gram-positive cocci, streptococci, pneumococci and Staphylococcus aureus were generally accepted as the primary etiological agents of nondiphtheritic infectious croup. Sinclair [3] in 1941 reported that a Gram-negative bacillus, H. influenzae type B, played an important etiological role in some cases. He isolated this organism repeatedly from rhinopharyngeal cultures and from blood cultures in cases of croup with supraglottic edema. This work has been confirmed by other investigators [4] and has given rise to the term "H. influenzae type B croup" [2c] to describe cases of supraglottic edematous obstructive laryngitis. However, while H. influenzae type B is often recovered in cases of this type of croup, it may be absent and other bacteria predominant.[5] While it is not common to find H. influenzae type B in other types of croup, it has been isolated occasionally in such cases.[2c] Moreover, the sequela of hypoxia that follows the local pathological changes of supraglottic edematous obstructive laryngitis has, in our experience, proved of more clinical importance than general toxic effects caused by the infectious agents. This has become particu-

3. Sinclair, S. E.: Hemophilus Influenzae Type B in Acute Laryngitis with Bacteremia, J. A. M. A. **117**:170-173 (July 19) 1941.

4. (*a*) Rabe.[2c] Rabe, E. F.: Infectious Croup: III. Hemophilus Influenzae Type B Croup, Pediatrics **2**:559-566 (June) 1948. (*b*) Alexander, H. E.; Ellis, C., and Leidy, G.: Treatment of Type-Specific Hemophilus Influenzae Infections in Infancy and Childhood, J. Pediat. **20**:673-698 (June) 1942. (*c*) Miller, A. H.: Hemophilus Influenzae Type B Epiglottitis or Acute Supraglottic Laryngitis in Children, Laryngoscope **58**:514-526 (June) 1948.

5. Gilbert, Meyersburg, and Silverberg,[1] Davison.[2c]

larly true since the use of antibiotics. For these reasons we believe that these cases could best be classified under the heading of "supraglottic edematous obstructive laryngitis."

In the other forms of infectious nondiphtheritic croup, pathogenic Gram-positive cocci can usually be recovered from rhinopharyngeal or laryngeal cultures.[6] It has been noted that no single bacterial species can be recovered in consistently high incidence and that bacteremia is infrequently present. In one study [2c] it was demonstrated that similar bacteria could be recovered from rhinopharyngeal cultures of presumably healthy persons in approximately the same incidence as from croup patients. With this as a basis, the conclusion was drawn that the Gram-positive cocci recovered from patients with croup are not the cause of the disease. It should be

TABLE 1.—*Mortality*

Year	Patients		Tracheotomies		O'Dwyer Type Intubations		Deaths Without Operative Intervention, No.
	Total No.*	Deaths, No.	No.	Deaths, No.	No.	Deaths, No.	
1950	303	1	20	1	0	..	0
1949	354	2	27	0	0	..	2
1948	283	3	10	2	0	..	1
1947	284	9	18	2	0	..	7
1946	208	8	16	1	0	..	7
1945 †	165	6	13	3	0	..	3
1944 †	171	12	17	5	0	..	7
1943 †	238	13	19	6	0	..	7
1942 †	198	5	29	2	0	..	3
1941	119	6	21	5	0	..	1
1940	150	16	18	9	5	3	4
1939	129	13	8	5	7	3	5
1938	121	7	5	3	6	1	3
1937	113	6	3	0	17	5	1
1936	102	5	1	0	12	3	2
1935	164	14	7	3	32	9	2
1934	113	10	3	3	14	4	3
1933	140	12	2	0	23	2	10
1932	142	17	2	2	21	10	5
1931	113	21	6	2	23	11	8
1930 ‡	...	..	..	..	..	..	..
1929	134	27	0	..	23	9	18
1928	98	22	0	..	20	17	5

* It would appear from this column that the incidence of nondiphtheritic infectious croup is increasing despite antibiotic therapy. This is not necessarily true. The Kingston Avenue Hospital for Contagious Diseases has the only organized croup service in Brooklyn and receives these patients (both service and private) from the entire borough. In recent years, physicians as well as the laity have become more aware of the special facilities for the treatment of croup available at this hospital and more frequently refer these patients to this hospital rather than attempt to treat them at home or at other hospitals. An increase in the population of the borough in the past 22 years is another factor in the apparent increase in the incidence of nondiphtheritic infectious croup as represented by the increase in the total number of patients treated at Kingston Avenue Hospital yearly.

† War years—during this period attending and house staffs were depleted.

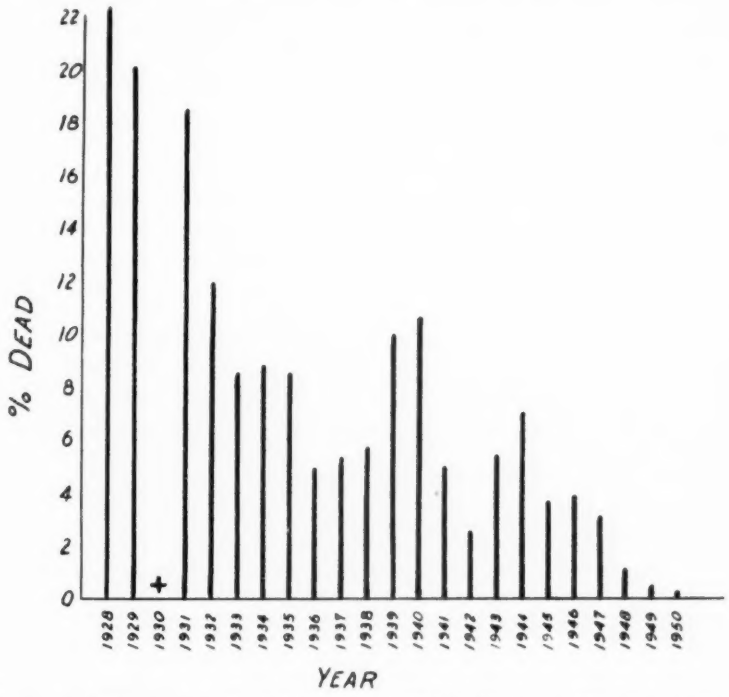
‡ Figures for 1930 were not available.

noted in passing, however, that the pathogenic bacterial flora also vary in different cases of tonsillitis, sinusitis, otitis media, and pneumonia, but the pathogenic bacteria present are accepted in most cases as the etiological agents of these conditions. It is to be noted that Neffson and Wishik,[7] in a study of laryngeal cultures, recovered a

6. (*a*) Neffson.[2b] (*b*) Rabe.[2c] (*c*) Davison.[2e] (*d*) Forfar, J. C.; Keay, K. R., and Thompson, J.: Acute Obstructive Laryngotracheitis and Laryngotracheobronchitis: Report of Outbreak, Lancet **1**:181-185 (Jan. 27) 1951.

7. Neffson, A. H., and Wishik, S. M.: Acute Infectious Croup: II. Nonspecific Infectious Croup, J. Pediat. **5**:617-647 (Nov.) 1934.

high percentage of pathogens in almost pure culture. Infrequent recovery of bacteria from the blood stream is insufficient evidence in itself that infection in the respiratory tract is not caused by pathogenic bacteria. Additional evidence that bacteria are important in the pathogenesis of nondiphtheritic infectious croup is derived from the fact that the introduction of the sulfonamides and penicillin—antibacterial drugs—and later of aureomycin, streptomycin, chloramphenicol, and terramycin has been accompanied by a great improvement in results. At Kingston Avenue Hospital, for example, there has been a marked decline in the past few years in the general mortality of croup cases and in the number of cases requiring surgical intervention (Table 1 and Chart). While part of this decline in mortality and severity is a result



Percentage fatality among all admissions for nondiphtheritic croup, Kingston Avenue Hospital, 1928-1950. Figures for 1930 were not available.

of better diagnosis and improved surgical technique for the relief of hypoxia, credit must also be given, in our opinion, to the antibacterial effects of such drugs as penicillin and aureomycin.

Failure to find a single bacterial species as the cause of infectious nondiphtheritic croup in cases without supraglottic edema has led to the belief that the etiological agent is nonbacterial. It has been postulated that a virus is the etiological agent [8]

8. (*a*) Rabe.[2c] (*b*) Morgan and Wishart.[2d] (*c*) Forfar, Keay, and Thompson.[6d] (*d*) Jeffrey, F. W.: Epidemic of Acute Laryngo-Tracheo-Bronchitis, Canad. M. A. J. **53**:562-564 (Dec.) 1945. (*e*) Rabe, E. F.: Infectious Croup: II. "Virus" Croup, Pediatrics **2**:415-427 (Oct.) 1948. (*f*) Brighton, G. R.: Laryngotracheobronchitis, Ann. Otol. Rhin. & Laryng. **49**:1070-1082 (Dec.) 1940.

and the term "virus croup" has been used to designate these cases.[9] However, it must be recognized that no virus has ever been demonstrated in human beings either by repeated direct isolation [8d] or by immunological studies to be the cause of infectious nondiphtheritic croup. It is, of course, entirely permissible to minimize the role of the demonstrable bacteria and to hypothesize that a virus is the etiological agent of the disease. The term "virus," however, has already been badly abused, and we feel that it should not be used to designate the causative agent of an infectious disease simply because no other single etiological agent is demonstrable. There is therefore little justification in our opinion to retain the term "virus croup" to cover cases classified by Gilbert and co-workers [1] as cases of acute catarrhal laryngotracheitis, subglottic exudative obstructive laryngotracheitis, subglottic edematous obstructive laryngotracheitis, and acute obstructive laryngotracheobronchitis.

It is necessary, however, to evaluate the role played by infectious etiologic agents in order to provide a rationale for specific antibiotic and chemotherapeutic treatment.

CLASSIFICATION

Acute Catarrhal Laryngitis and Tracheitis.—This is the commonest and most benign type of infectious croup. These patients have a brassy cough, hoarseness, and mild suprasternal, intercostal, and epigastric retractions. Although laryngoscopy is not necessary, it may be performed if doubt exists as to diagnosis. The larynx appears red and velvety, and a mucoid secretion may be seen on the vocal cords extending into the subglottic area. This secretion is easily aspirated, leaving a reddened mucosa in the subglottic area and upper trachea. The cords move freely at all times. These patients usually respond well to increased humidification of the air, such as is afforded by steam. This is especially effective because these patients, as a rule, become ill in rooms that are overheated and low in humidity. It has been our impression that penicillin and aureomycin shorten the course of acute catarrhal laryngitis and tracheitis and probably often prevent progression to the more serious types of croup to be discussed below; however, even before the use of antibiotic therapy, the prognosis was uniformly good.

Subglottic Obstructive Laryngitis and Tracheitis.—This is a more serious condition, occurring most frequently in children under the age of 2 years. It is divided into (*a*) the exudative or inspissated type and (*b*) the edematous type.

Subglottic Exudative (or Inspissated) Obstructive Laryngitis and Tracheitis: This condition is accompanied by intense suprasternal, intercostal, and epigastric retractions, hoarseness, brassy cough, and at times cyanosis. Usually the symptoms are sufficiently severe to require laryngoscopy. Laryngoscopic inspection reveals the vocal cords nearly in the midline, separated slightly by moist exudate or green-gray or black dry crusts. The cords are almost immobile. Aspiration of the exudate and removal of the crusts reveal a congested nonedematous mucosa in the subglottic area. After aspiration, the cords move freely, and immediate relief of the respiratory distress follows. If respiratory distress occurs again, it may be necessary to repeat laryngoscopy and aspiration. Another means which might lead to removal of the accumulated secretions and crusts is vomiting induced by ipecac. However, we do not advocate the use of ipecac, since the vomitus may easily be aspirated into the lungs. Moreover, laryngoscopy, in addition to affording the best means of relieving

9. Footnotes 2*c* and 8*c*.

the hypoxia of the exudative type of subglottic obstructive laryngitis, enables the physician to be assured that he is not dealing with the types of croup which require tracheotomy and in which nothing can be gained by delaying operative intervention.

Subglottic Edematous Obstructive Laryngitis and Tracheitis: These patients present symptoms similar to those of the exudative type of obstructive laryngitis and tracheitis, but cyanosis, pallor, and tachycardia, signs of hypoxia, are more sustained and more severe. In these cases laryngoscopy should be done. Laryngoscopy reveals normal supraglottic structures but one or both cords are only slightly mobile or rigidly fixed near the midline. Suction fails, however, to influence the relative position of the cords or to increase their mobility. The major cause of interference with the airway is subglottic edema frequently involving the juncture of the cord and arytenoid preventing motion of the cords. This edema prevents entrance of air into the lungs not only by narrowing the airway but also by preventing abduction of the true cords during inspiration. It should be noted that when the edema subsides, the cords move freely once more. (We believe that Gilbert and his colleagues [1] were the first to report fixation of the cords in nondiphtheritic croup cases and stress the importance of this finding.) In our experience, tracheotomy has been the treatment of choice for this condition. Examples of this type of croup follow.

CASE 1.—A 10-month-old white girl was admitted to Kingston Avenue Hospital on March 3, 1950, with a one-day history of fever, hoarseness, brassy cough, and difficulty in breathing. On admission she appeared acutely ill. Suprasternal and slight intercostal retractions were present, and her temperature was 101 F. The child was placed in an oxygen tent and given 300,000 units of penicillin procaine for aqueous injection intramuscularly. In the ensuing hours, despite this treatment, her condition gradually grew worse. Her lips became pale, her pulse rapid and shallow, and her retractions more marked. She was taken to the operating room, but while being prepared for laryngoscopy she suddenly ceased breathing. After artificial respiration had improved her condition slightly, laryngoscopy was performed. The true cords were inflamed and almost immobile, and the subglottic area appeared completely closed off by edema. A 3.5 mm. bronchoscope was introduced with considerable force past the area of subglottic edema. The trachea and bronchial tree were filled with mucopurulent secretions, and the tracheal mucosa was acutely inflamed. With the bronchoscope in place, tracheotomy was performed. The child left the operating room in good condition, with regular respiration. One hundred thousand units of crystalline penicillin G sodium in aqueous solution was administered intramuscularly every three hours, and 50 mg. of aureomycin was administered orally every six hours following tracheotomy. Recovery after tracheotomy was uneventful. Administration of aureomycin was discontinued on March 7. Partial closure of the opening of the tracheotomy tube was initiated on March 16; the tube was completely blocked on March 18 and removed on March 20. Use of penicillin was discontinued on March 22. The child was discharged on March 23 with the tracheotomy wound healed. A throat culture on admission disclosed Staph. aureus, H. influenzae, an anhemolytic (gamma) Streptococcus and Escherichia coli. A chest roentgenogram on March 6 showed no abnormalities. A blood count on March 5 disclosed a hemoglobin level of 10.0 gm., 3,800,000 red cells and 7,100 white cells, of which 36% were polymorphonuclear leukocytes and 64% lymphocytes.

Comment.—This case illustrates the fulminating course that subglottic edematous obstructive laryngotracheitis may take. The total time from onset of symptoms to tracheotomy was less than 36 hours. Earlier tracheotomy might have been desirable, since best results are not obtained by waiting until the patient is exhausted before the operation is performed. This type of croup is seen most frequently in children under the age of 2 years, although it occasionally occurs in older children. Children under the age of 2 years normally have a small subglottic space and a

narrow tracheal lumen. Moderate subglottic edema can easily diminish the airway markedly, and severe edema can close it almost completely. The supraglottic structures are not involved in this type of croup.

Before 1941 most of these cases were treated at Kingston Avenue Hospital by the O'Dwyer type of intubation, but in that year the procedure was abandoned in favor of tracheotomy (Table 1). It was felt that the disadvantages of intubation —i. e., increase of tracheal edema by direct pressure on an already insulted mucosa as well as edema extending and blockading the lower end of the tube; autoextubation necessitating immediate reintubation; blockade of the intubation tube by exudate; trauma to the larynx incident to prolonged intubation, with subsequent laryngeal ulceration and a sequela of stenosis, and frequent necessity for tracheotomy despite intubation—outweighed the advantages—i. e., avoidance of a tracheotomy scar and a possible lower incidence of pneumothorax and pneumomediastinum. Since the complete substitution of tracheotomy for intubation, our mortality in cases with subglottic edema has dropped considerably (Table 2). Although some of this improvement is due to the introduction of chemotherapeutic and antibiotic agents, we feel that much is due to the change in surgical procedure for the relief of hypoxia.

Case 2.—A 2½-year-old white girl was admitted to Kingston Avenue Hospital on March 5, 1950, with a three-day history of brassy cough, fever, and progressive dyspnea. The child had

Table 2.—*Mortality Statistics*

Years	Procedure	Number of Patients	Number Dead	Mortality, %
1941-1950	Tracheotomy	190	27	14.2
1928-1940	Intubation (O'Dwyer)	203	77	37.9

received sulfadiazine and penicillin at home from the onset of her illness. On admission, although her temperature was 99.6 F. she was acutely ill, restless, and markedly dyspneic. Suprasternal, infrasternal, and intercostal retractions were present, and inspiratory stridor was marked. The lungs were tympanitic and the breath sounds diminished. Aqueous crystalline penicillin G sodium solution, 100,000 units every three hours intramuscularly, and aureomycin, 50 mg. every four hours by mouth, were administered. The child experienced no relief from either steam or oxygen, and therefore after a few hours laryngoscopy was performed. The vocal cords moved poorly and were covered with thick mucus, and marked subglottic edema was present. The epiglottis was not edematous. A bronchoscope was passed, and tracheotomy was performed with the bronchoscope in situ. Marked improvement immediately followed tracheotomy. Restlessness ceased, and the child was soon sleeping comfortably. Subcutaneous emphysema was present in the tissues of the neck on the following day. A chest roentgenogram at that time disclosed neither pneumothorax nor pneumomediastinum and no consolidation. Without further surgical intervention, the air was absorbed spontaneously. Administration of aureomycin was discontinued on March 12 and of penicillin on March 22. The tracheotomy tube was removed on March 20, and the child was discharged on March 25 with her wound healed. Hemolytic streptococci were recovered from pharyngeal and laryngeal cultures. The blood count on admission showed 3,700,000 red cells and 9,300 white cells, with polymorphonuclears 54%, lymphocytes 44%, and monocytes 2%.

Comment.—This case is an example of subglottic obstructive edematous laryngitis and tracheitis, which runs a slower course and despite antibiotic and chemotherapeutic agents culminates in such severe subglottic edema that tracheotomy is necessary to relieve hypoxia. Whether the failure of antibiotic and chemotherapeutic agents in such cases is due to the presence of resistant micro-organisms, or whether, once the pathological process has been initiated, the edema becomes more extensive despite the bacteriostatic effect of the drugs, remains to be determined.

The extreme restlessness noted in this patient is often seen in patients suffering from hypoxia. In our opinion, sedatives should not be used, since they tend to disguise symptoms and by depressing respiration may actually increase hypoxia. Relief of hypoxia will end this type of restlessness.

Subcutaneous emphysema as noted in this case is in itself of little consequence. However, it may be related to more serious phenomena, such as pneumothorax and pneumomediastinum, as illustrated in the following case of subglottic edema.

CASE 3.—A 6-year-old white girl was admitted to Kingston Avenue Hospital on March 9, 1950, at the point of death. The child became ill about eight hours prior to admission, with fever, brassy cough and progressive respiratory difficulty. While attempting to eat supper, she experienced such great difficulty in breathing that she lost consciousness and was rushed to the hospital. On admission the child was unconscious and deeply cyanotic. There were marked suprasternal, intercostal, and substernal retractions and almost complete absence of breath sounds. The pharynx was slightly inflamed, but the epiglottis was not edematous.

After the administration of oxygen and artificial respiration, laryngoscopy was performed. Marked subglottic edema, more pronounced on the left side, was noted. The cords moved poorly. Bronchoscopy revealed a trachea filled with a thin secretion and thick purulent material exuding from the right lower lobe bronchus. After suctioning, the child regained consciousness. With the bronchoscope in situ a tracheotomy was performed. The patient did well and left the operating room in good condition. A blood count disclosed hemoglobin 13.0 gm., red cells 4,600,000, and white cells 13,400, with polymorphonuclears 74%, lymphocytes 20%, and monocytes 6%. Aqueous solution of crystalline penicillin G sodium, 100,000 units intramuscularly every three hours, and aureomycin, 250 mg. every six hours by mouth, were administered.

On the following morning, although the child appeared comfortable, slight dyspnea was noted. Subcutaneous emphysema was present in the neck and over the right hemithorax, and the breath sounds were diminished over the right side. Chest roentgenograms disclosed a pneumomediastinum with a right pneumothorax with one third of the right lung collapsed. As the day progressed, more dyspnea, with restlessness and slight cyanosis, gradually developed. The apex beat was displaced 2 cm. to the left. No relief was obtained from use of an oxygen tent. Finally, a needle, connected by tubing to a pneumothorax machine with the bottles reversed, was introduced into the right hemithorax. The initial pressure was 20 cm. of water; after the removal of 300 cc. of air, the pressure was —5 cm. of water. While the actual figures may not represent basal conditions because of the restlessness and crying of the child, the dramatic change in pressure and the subsequent relief of symptoms strongly suggest the presence of a tension pneumothorax. After the aspiration of air from the chest, the child appeared more comfortable, with less dyspnea, and increased breath sounds were heard over the right hemithorax. Chest roentgenograms taken at this time disclosed the right pneumothorax to be less pronounced and there was no longer any shift of the mediastinum. Pneumomediastinum was still present, and there was no increase in the amount of subcutaneous emphysema. By March 11, the child was markedly improved. Subcutaneous emphysema could still be detected, but breath sounds were normal. Chest roentgenograms on March 11 disclosed almost complete reexpansion of the right lung, with marked decrease in the pneumomediastinum and subcutaneous emphysema. Recovery from then on was uneventful. Administration of aqueous crystalline penicillin G sodium was discontinued on March 11, and 300,000 units of procaine penicillin in aqueous solution was administered intramuscularly daily. The tracheotomy tube was blocked on March 18 and was removed on March 20. Use of aureomycin was discontinued on March 16 and of penicillin on March 22. The child was discharged on March 24.

Comment, with Special Reference to Subcutaneous Emphysema, Pneumomediastinum, and Pneumothorax.—It is to be noted that after a marked improvement following tracheotomy, this patient again manifested signs of hypoxia despite an adequate airway. In a child with croup who continues to show signs of hypoxia or in whom hypoxia develops again after initial improvement following the establishment of an adequate airway by tracheotomy, the presence of pneumomediastinum, pneumothorax, or both should be considered. In fact, routine chest roentgeno-

grams taken at our hospital after tracheotomy have disclosed the presence of small degrees of pneumothorax or pneumomediastinum in many cases with no clinical signs of their presence. In most cases the existence of small degrees of pneumomediastinum or pneumothorax is of little consequence and no special treatment is required. On the other hand, if hypoxia becomes severe enough, steps should be taken to obtain relief. To relieve pneumothorax, aspiration of air from the chest, either with the aid of a pneumothorax machine with the bottles reversed or simple aspiration with a syringe, may result in improvement. If a persistent bronchopleural fistula is present, however, underwater drainage may be indicated. If pneumomediastinum becomes severe enough to necessitate operative intervention, a vertical incision is made in the midline of the neck in the suprasternal notch. With blunt dissection the pretracheal fascia is reached; closed curved scissors are pointed down toward the superior mediastinum, and the scissors are then opened. After this, trapped air is seen to bubble up from the mediastinum, and relief is thus obtained. No drains of any sort are used. The wound closes spontaneously when the pressures in the mediastinum and outside atmosphere are equalized.

The pathophysiological mechanisms involved in the development of pneumomediastinum, pneumothorax, subcutaneous emphysema, and pneumopericardium complicating croup need further study. While a full discussion of this subject is beyond the scope of this paper, it is of interest to summarize briefly the theories proposed to explain the development of these complications.

It is an established fact that these complications can occur in croup without the presence of a tracheotomy wound. As the result of a ball-valve-like mechanism arising from a localized obstructive exudative and edematous condition of the bronchi and bronchioles, air may be trapped and a localized emphysema of the alveoli take place. Forcible expiration and coughing in the face of obstruction in the larynx may suddenly cause increased intra-alveolar pressure in these emphysematous areas. Rupture of alveoli with the development of interstitial pulmonary emphysema may follow. Macklin [10] believes that distended alveoli adjacent to pulmonary vessels are particularly vulnerable. The interstitial air may then dissect its way along the pulmonary vessels to the mediastinum, causing pneumomediastinum. From the mediastinum it may find its way to the neck, retroperitoneal areas, pericardium,[11] and pleural spaces. Another possible explanation is that sudden increases of intrapulmonary pressure may result in localized areas of bullous emphysema in alveoli in subpleural areas and that these may rupture and give rise to pneumothorax and pneumomediastinum. It has also been suggested [10] that localized compensatory emphysema as a result of atelectasis due to bronchial obstruction may be a factor in establishing a pulmonary air pressure gradient to the pulmonary vessels in the emphysematous areas. Although this hypothesis should be explored, it seems unlikely to us that compensatory emphysema of this nature occurs in croup, because the acute course of the disease does not provide sufficient time for the operation of this mechanism.

10. Macklin, M. T., and Macklin, C. G.: Malignant Interstitial Emphysema of the Lungs and Mediastinum as an Important Occult Complication in Many Respiratory Diseases and Other Conditions: An Interpretation of the Clinical Literature in the Light of Laboratory Experiment, Medicine **23**:281-358 (Dec.) 1944.

11. (*a*) Gilbert, Meyersburg and Silverberg.[1] (*b*) Forbes, G. B.; Salmon, G., and Herweg, J. C.: Further Observations on Post-Tracheotomy, Mediastinal Emphysema, and Pneumothorax, J. Pediat. **31**:172-194 (Aug.) 1947. Gruebner, H.: Pneumopericardium and Pneumomediastinum in Cases of Acute Obstructive Laryngitis, Arch. Otolaryng. **29**:446-456 (March) 1939.

It should be apparent that violent struggling during tracheotomy will increase the likelihood of development of interstitial pulmonary emphysema, pneumothorax, and pneumomediastinum by way of these intrinsic mechanisms, particularly if an adequate airway is not in situ during the operation. If obstruction is not relieved after tracheotomy, because of the accumulation of secretions either in the tracheotomy tube or in the bronchi and bronchioles, the same intrinsic mechanisms may give rise to pneumothorax, pneumomediastinum, pulmonary interstitial emphysema, and subcutaneous emphysema postoperatively.

Another possible mechanism for the production of these complications is associated with trauma during tracheotomy. During surgery, the thin bulging dome of the parietal pleura or Sibson's fascia may be nicked or torn. These injuries may result in pneumothorax, pneumomediastinum, or subcutaneous emphysema. Moreover, after such injury, coughing or forced expiration in the presence of an obstructed airway may subsequently force an escape of air through a traumatically produced bronchopleural fistula. With an airway in situ during surgery, a child is more likely to be quiet and the possibility of mechanical injury is reduced. The presence of an adequate airway also reduces the likelihood of sudden increases in intrapulmonic pressure during surgery.

A third mechanism has been proposed by Neffson [2b] to explain the frequent development of these complications during and after tracheotomy. According to this theory, in the presence of laryngeal obstruction the exaggerated respiratory movements increase the negative pressure within the chest. During and after tracheotomy, air may be sucked into the neck and then dissect its way to the mediastinum, propelled by the sucking action of the negative pressure in the mediastinum combined with sudden increases in pressure produced by coughing against an obstructed airway. This theory proposes a sucking mechanism essentially similar to sucking wounds of the thorax, in which atmospheric pressure exceeds that of the pleural cavities. Forbes and co-workers [11b] demonstrated that in dogs a dye could find its way to the mediastinum after tracheotomy, presumably by this mechanism, and felt that air could follow the same course. Since obstruction in croup is expiratory as well as inspiratory, it is doubtful, in our opinion, that this mechanism is valid. It should, however, be explored further.

While the pathophysiological mechanisms are not altogether clear, the possibility that pneumomediastinum, pneumothorax, and pulmonary interstitial emphysema may complicate croup should be kept in mind, and further efforts should be made to find methods of reducing the frequency of these complications.

SUPRAGLOTTIC EDEMATOUS OBSTRUCTIVE LARYNGITIS

Supraglottic edematous obstructive laryngitis has become more widely known and understood in recent years, but the differences in pathology, symptomatology, and treatment of this type of croup are often not appreciated by those who have not had the opportunity to observe these cases frequently.

The patients are usually children over the age of 3 years. As in the other types of croup already discussed, there are suprasternal and epigastric retractions, stridor, and a brassy cough. The voice is peculiarly wavering and guttural and has been described as having a "hot potato" quality. These patients characteristically assume an upright position, with their chins forward and their mouths open. Respiratory distress increases in the recumbent position. The supraglottic structures—the epiglottis, aryepiglottic folds, and arytenoids—are frequently edematous. The edema

of the arytenoid may extend to its juncture with the cord or cricoarytenoid joint, with resulting fixation of the cord on the affected side. If the process is bilateral, both cords become immobile and extreme hypoxia results. Rarely does one find a coexisting subglottic edema in cases of supraglottic obstructive edematous laryngitis. With few exceptions, immediate tracheotomy is advisable, since despite antibiotic therapy severe hypoxia can develop with great rapidity. The O'Dwyer type of intubation should never be performed in these cases because the opening of the intubation tube may be blocked by the swollen supraglottic structures. The following cases illustrate some of the problems encountered in this type of croup.

CASE 4.—A 4½-year-old white boy was admitted to Kingston Avenue Hospital on March 18, 1950. Four hours before admission he had become hoarse, and stridor, dyspnea, low-grade fever, and supraclavicular, intercostal, and slight infrasternal retractions had gradually developed. He was given penicillin and ipecac syrup at home but obtained no relief. On admission he was acutely ill, with marked inspiratory stridor and marked supraclavicular and intercostal retractions. He assumed the position usually observed in these cases—sitting erect with head thrown forward and mouth opened wide. His respiratory rate was 50 per minute. His voice was hoarse and "hot potato" in character. Examination of the pharynx showed the epiglottis to be three times normal size and beefy red. Breath sounds were diminished over the thorax. The patient was maintained in the semierect position in order to forestall the severer hypoxia which follows assumption of the reclining position in such a case. On laryngoscopy, performed a half-hour after admission, the enlarged epiglottis was again visualized and the arytenoids and aryepiglottic folds were also noted to be edematous. The true cords and subglottic tissues, while injected, were not edematous. There was limited mobility of the cords. A bronchoscope was passed, and tracheotomy was performed with the bronchoscope in place. The child left the operating room comfortable and in good condition. H. influenzae was recovered from pharyngeal culture. The blood count disclosed 12.5 gm. of hemoglobin, 4,350,000 red cells, and 29,300 white cells, with 81% polymorphonuclears and 19% lymphocytes. A chest roentgenogram disclosed no infiltration or consolidation. Aqueous crystalline penicillin G sodium, 200,000 units every three hours intramuscularly, and aureomycin, 100 mg. every six hours by mouth, were administered. The child recovered with no further complications. By March 23, the epiglottis had returned to normal size. The tracheotomy tube was completely blocked on March 23 and removed on March 24. The child was discharged on March 25 with the tracheotomy wound healing nicely.

Comment.—This is a typical case of supraglottic edematous obstructive laryngitis. The five-hour history (onset to tracheotomy) illustrates the fulminating nature of the disease. Diagnosis was promptly made not only from the symptomatology and history but by noting the position of the patient—sitting up with chin forward and down and mouth open wide—and by visualization of the enlarged epiglottis. The epiglottis can be easily visualized in these cases if the tongue is brought forward as well as downward with the tongue depressor. Had tracheotomy not been performed promptly, we have every reason to believe from our experience in other cases that respiratory difficulty would have continued to increase despite use of oxygen, steam, or antibiotics. It is interesting to note that H. influenzae almost in pure culture was recovered from this child's pharynx. Although we have been unable to recover H. influenzae in as large a proportion of these cases as have other investigators, the frequent occurrence of this organism in this type of croup suggests that therapy should include such drugs as aureomycin, chloramphenicol, or terramycin, to which H. influenzae is susceptible.

CASE 5.—A 2½-year-old white boy was admitted to Kingston Avenue Hospital on March 4, 1950, with the following history: He had gone to sleep on March 3 perfectly well and had awakened at 3 a. m., March 4, with cough, hoarseness, and noisy respiration. The child was seen promptly by a physician, who administered penicillin and prescribed a cough mixture. Despite this treatment, the child rapidly became worse. A pediatrician and a laryngologist were

summoned, and it was decided to move the child to Kingston Avenue Hospital for tracheotomy. However, when the child was laid on the ambulance stretcher, he became deeply cyanotic and ceased breathing. Tracheotomy was performed at once in the home. After the tracheotomy, the child improved rapidly, regained consciousness, and was then moved to Kingston Avenue Hospital.

On admission the child was restless but his color and general condition were good. The temperature was 100.4 F. Examination of the pharynx showed the epiglottis to be three times normal size. The chest roentgenogram showed no abnormalities. The blood count was as follows: hemoglobin, 11.5 gm.; red cells, 4,500,000; white cells, 12,400, with polymorphonuclears 76%, lymphocytes 20%, and monocytes 4%. The child was given 100,000 units of aqueous crystalline penicillin G sodium every three hours intramuscularly and 100 mg. of aureomycin every six hours by mouth. Administration of aureomycin was discontinued on March 9 and of penicillin on March 13. The tracheotomy tube was blocked on March 18 and removed on March 21. The child was discharged on March 23 with his wound well healed.

Comment.—This case again illustrates that the fulminating nature of supraglottic edematous obstructive laryngitis makes early diagnosis imperative. These patients characteristically assume an upright position with their chins forward and their mouths open. Respiratory distress increases when they are placed in the recumbent position and may even be disastrous. Therefore, once the presence of supraglottic edematous obstructive laryngitis is suspected, the patient should be maintained in the sitting position at all times, i. e., during transportation to the hospital and from the ward to the operating room until the very moment when a bronchoscope or other airway is passed into the trachea by means of a laryngoscope. This is, of course, followed by tracheotomy.

Hypoxia may also occur in an unusual and little known type of supraglottic laryngitis in which the epiglottis is not swollen but the arytenoids are edematous and the true cords are fixed (probably because of edema in the thyroarytenoid and cricoarytenoid joints). Antibiotic therapy cannot be relied upon to overcome the edema present in these critical areas quickly enough to prevent the necessity for tracheotomy. The "hot potato" voice and the characteristic position are not present in these cases because of the absence of a swollen epiglottis. Diagnosis can be made by laryngoscopy. We recently observed this condition in a 12-year-old boy admitted to our service.

ACUTE OBSTRUCTIVE LARYNGOTRACHEOBRONCHITIS

Acute obstructive laryngotracheobronchitis is a rare but serious type of croup which occurs in infants, under 2 years of age as a rule and most frequently under 1 year of age. They are severely ill, toxic in appearance, having a pale cyanosis, pronounced suprasternal and infrasternal retractions, high mounting temperature, rapid pulse, and increased respirations. (In the terminal stage they are in collapse, with practically no respiratory effort visible.) There frequently are areas of atelectasis and associated bronchopneumonia.

We use the term "acute obstructive laryngotracheobronchitis" to designate only the specific type of croup described below. Unfortunately, the term "acute laryngotracheobronchitis" has been used loosely by others to cover all types of nondiphtheritic infectious croup. Clinicians in using the term "acute laryngotracheobronchitis" so frequently fail to realize that croup is composed of several definite clinical and pathological entities, each carrying its own mortality and morbidity, that a wide discrepancy in mortality and morbidity statistics has arisen as a result of this. Moreover, the loose employment of the term "acute laryngotracheobronchitis" leads to the false conclusion that the condition of acute obstructive laryngotracheobronchitis is very common. Fortunately, in our experience in the past 10 years,

comprising a total of 2,550 cases of nondiphtheritic infectious croup, acute obstructive laryngotracheobronchitis occurred in less than 8% of the cases.

It will be noted that with prompt diagnosis and proper therapy most of the patients with the other types of croup can be helped. Acute obstructive laryngotracheobronchitis, however, even with the best of treatment, still carries a very high mortality. The reason for this becomes apparent when the pathology present is understood. In this condition subglottic edematous obstructive laryngitis with fixed cords is combined with edematous tracheobronchitis and a mucopurulent exudate or a gummy material which extends into the smallest bronchial radicles. Thus while tracheotomy is necessary, the operation does not result in the same degree of amelioration of hypoxia obtained in the other types of croup. Ordinary aspiration through the tracheotomy tube with a rubber catheter in these cases often fails to relieve the obstructive symptoms, and aspiration through the tracheotomy wound with a bronchoscope (the tracheotomy tube having been removed) is usually necessary. However, even this procedure may fail to alleviate hypoxia if the obstructing exudate fills, as it usually does, many of the smallest bronchial radicles. While in other types of croup tracheobronchial exudate is often increased after tracheotomy, in these cases the bronchial exudate is present in large amounts before tracheotomy. In order to reduce the mortality of this type of croup, a substance is needed that can be introduced into the tracheobronchial tree without damage to the tissues and yet could dissolve the peculiar yellowish "soap rubber" type of material which plugs the bronchioles. No such substance has been found up to the time of writing, although we have tried many substances. At the present time we believe that this fortunately rare condition still carries a mortality of about 70%. It should not be confused with the other types of croup discussed above, which are most amenable to therapy.

USE OF ANTIBIOTIC AND CHEMOTHERAPEUTIC AGENTS IN CROUP

Since many pathogenic micro-organisms, either as primary etiological agents or as secondary invaders, are involved in nondiphtheritic infectious croup, it is evident that selection of the best combinations of antibiotic and chemotherapeutic drugs for an individual case may present a difficult problem. While theoretically the proper drugs could be selected on the basis of the reports of the department of bacteriology, the rapid course of croup usually makes this impractical. The physician is forced to employ empirically relatively nontoxic drugs with a broad antibacterial spectrum, altering or maintaining a particular regimen according to the response of the patient.

Penicillin has proved of value in most of our cases and is now used routinely on our service. Since the quick achievement of high levels is considered desirable, we use aqueous crystalline penicillin sodium and administer the drug in large doses at frequent intervals. At least 100,000 units of aqueous crystalline penicillin G sodium is administered intramuscularly every three hours. We have also obtained good results from the use of aureomycin in conjunction with penicillin and now use aureomycin on our service from the beginning of treatment. We use at least 25 mg. per kilogram of body weight per day, divided into six oral doses given every four hours. Aureomycin is effective against H. influenzae and many of the pyogenic cocci resistant to penicillin. The difficulty that some croup patients have in swallowing medication has on occasion limited its usefulness. While the intravenous route of administration would overcome this difficulty, it is disturbing to seriously ill patients and may increase their excitement and their respiratory difficulty. While

we have had no experience with terramycin,[12] the similarity of its properties and its antibacterial spectrum to those of aureomycin would indicate that it will prove of about the same value and will have the same limitations. Chloramphenicol[13] has also been reported to be useful in treatment of croup. Since this drug can be administered efficaciously by rectum and since a suitable intramuscular preparation is under study,[14] it may find a more important place in the management of croup. Streptomycin has proved useful in the hands of several investigators.[15] Effective against a great variety of Gram-positive and Gram-negative organisms, it was until recently the only effective antibiotic available against H. influenzae and was particularly recommended for use in infections caused by this organism. In the doses required for the effective treatment of croup, we believe that streptomycin may cause vestibular damage.[16] The sulfonamides are no longer the drugs of choice but are still of value in selected cases. We no longer use them routinely. Since the development of aureomycin, chloramphenicol, terramycin and streptomycin, we see no further use for anti-Hemophilus-influenzae type B serum in treatment of croup.

It has been reported that certain combinations of antibiotic and chemotherapeutic drugs when used concurrently may interfere with the therapeutic activity of one another.[17] Thus, even if the increased incidence of toxic effects from the use of many drugs concurrently is disregarded, it should be emphasized that the achievement of maximum therapeutic effect is not simply a matter of employing all the available drugs in large doses from the beginning of treatment. The most effective combinations of drugs for the treatment of infectious nondiphtheritic croup are a matter for further investigation.

ANALYSIS OF DATA IN 2,602 CASES OF CROUP (1939-1950)

Prior to 1939, croup was practically under the sole control of the pediatric division, with the laryngologist acting as an adjunct service subject to call by the pediatric division. Since 1939, when we became associated with the hospital, the laryngological service has become responsible for the care of croup cases, while the pediatrician remains responsible for any pneumonitis or other pediatric problems which patients with croup might have. Under this regimen, it has been possible for the laryngologist to take care of these patients from the time of their admission

12. Herrell, W. E.; Heilman, F. R., and Wellman, W. E.: Some Bacteriologic, Pharmacologic, and Clinical Observations on Terramycin, Ann. New York Acad. Sc. **53**:448-458 (Sept. 15) 1950.

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15. Rabe.[2c] Garson, J. Z.: Acute Laryngo-Tracheo-Bronchitis, Brit. M. J. **1**:578-579 (March 11) 1950.

16. Gilbert, J. G.; Aranoff, J. S., and Rosen, D. M.: Streptomycin Therapy in Otolaryngologic Tuberculosis, Quart. Bull. Sea View Hosp. **10**:3-26 (Jan.) 1948. Gilbert, J. G., and Aranoff, J. S.: The Role of Streptomycin, Paraaminosalicylic Acid and Tibione in the Therapy of Tuberculosis of the Larynx, A. M. A. Arch. Otolaryng., to be published.

17. Dowling, H. F.: Present Status of Antibiotic Therapy, Antibiotics & Chemotherapy **1**:2-6 (April) 1951. Jawetz, E.; Gunnison, J. B.; Speck, R. S., and Coleman, U. R.: Studies on Antibiotic Synergism and Antagonism: The Interference of Chloramphenicol with the Action of Penicillin, A. M. A. Arch. Int. Med. **87**:349-359 (March) 1951.

to the hospital until final disposition is made. This has afforded the laryngological service an opportunity to see the pathological state in its inception and to observe the progress of the disease without interruption. As the result of this, we have been able to classify our cases better.

It must be recognized from the outset that we are dealing with a heterogeneous group of cases, the nature of which varies to some extent from year to year. Bearing this in mind, we have nevertheless been able to draw certain deductions from the data available.

Prior to 1939, intubation with the O'Dwyer tube was the method of choice in the treatment of severely ill croup patients. In the early years, the tube was passed blindly without the aid of laryngoscopy. Subsequently this method was abandoned in favor of insertion of the tube through the laryngoscope. This gave rise to much more favorable results (Table 1). Nevertheless, this method was found wanting because no real attempt was made to recognize the pathology present in the larynx

TABLE 3.—*Tracheotomies*

Years	Number of Patients	Number Dead	Mortality, %
1946-1950	91	6	6.5
1941-1945	99	21	21.6
1936-1940	35 *	17 *	48.5
1931-1935	20 *	10 *	50.0

* In some of these cases intubation with the O'Dwyer tube was first done, and this procedure was followed by tracheotomy when the patient's condition became very bad.

and tracheobronchial tree, and an empirical method of treatment was therefore being used. In addition, even if temporary relief was obtained from its use—as we stated in 1941 [1]—

this alone does not guarantee permanent relief, because thick exudate coming from the trachea and bronchi may block the lumen of the intubation tube without warning and cause a recurrence of the distressing signs which first prompted intervention. The subglottic laryngeal and tracheal edema may spread down and cover the lower end of the tube, again provoking retractions, cyanosis and other indications of involvement. Not infrequently, autoextubation may occur, with return of the original symptoms, after which reintubation may not give relief. Repeated autoextubation causes anxiety to the patient and to the physician, lest the occurrence go unnoticed. A final decision must be made promptly regarding the alternate procedure (tracheotomy).

Laryngeal stenosis may result from prolonged intubation or frequent reintubation. The insertion of oversized tubes and their forceful removal may be responsible for extensive damage to tissues and consequent atresia. Lesser evils from the use of intubation tubes are ulcerations of the larynx and trachea, pretracheal abscess, webs of the larynx and fixation of the cords.

Since we abandoned the use of the O'Dwyer type of intubation in 1941 for a more specific therapy for each type of croup (as noted above in our classification) there has been a definite improvement in our results. This is reflected in a study of Table 2, which discloses that during the years 1928-1940 use of intubation as the primary procedure gave rise to a mortality of 37.9%, and from 1941-1950 with use of tracheotomy as the procedure of choice, the mortality fell to 14.2%. A study of Table 3 reveals that the mortality in cases in which tracheotomy was done has been dropping rapidly with each five year period starting with 1941, when intubation was abandoned—i. e., from 1941 to 1945 a 21.6% mortality and from 1946 to 1950 only a 6.5% mortality. What is more, because of a better understanding of croup, we have found it less necessary to use artificial airways. Our records show a drop

from 26% in 1928 to 6% in 1950. It should be noted, however, that it was still necessary to perform tracheotomy on 20 of the patients with croup admitted in 1950. Because of the early hypoxia associated with many of the obstructing fulminating infections, we do not anticipate much further reduction in this figure within the near future. Tracheotomy, in our opinion, retains an important place in the treatment of many patients with severe infectious nondiphtheritic croup.

The degree of improvement we have obtained in the management of cases of croup may be noted by examination of Table 1 and the Chart. Our case fatality has declined from 23% in 1928 to 0.5% in 1950. We attribute the decline in case fatality to the following factors: early laryngoscopy; proper classification of cases; adequate administration of antibiotics; appropriate use of steam and oxygen; tracheotomy performed at the appropriate time, with an airway in situ during the operation; careful postoperative care of tracheotomized patients, with particular attention to the aspiration of accumulated secretions in the airway, and constant awareness of the possibility of a complicating pneumothorax and pneumomediastinum.

SUMMARY AND CONCLUSIONS

Our experience with 2,602 patients with nondiphtheritic infectious croup treated at Kingston Avenue Hospital during the past twelve years allows for the following conclusions:

1. Despite recent advances in antibiotic therapy, surgical intervention to relieve hypoxia is still frequently necessary in cases of nondiphtheritic infectious croup.

2. A classification of nondiphtheritic infectious croup based on the pathological changes involved has many advantages over classifications based on infectious etiological agents. Such a classification is described and each type of croup is discussed in detail with several illustrative cases. This classification, in use for over 10 years, has been found very satisfactory.

3. Patients with acute catarrhal laryngotracheitis can be managed by humidification of the air and antibiotic therapy. Patients with subglottic exudative obstructive laryngotracheitis may require endoscopic aspiration of the exudate and mechanical removal of accumulated crusts. Most patients with subglottic edematous obstructive laryngotracheitis and supraglottic edematous obstructive laryngitis require tracheotomy. Patients with acute obstructive laryngotracheobronchitis, fortunately quite rare, require tracheotomy but are only partially relieved of hypoxia by this operation. Most of them still die in spite of treatment because of bronchial and bronchiolar obstruction. The O'Dwyer type of intubation was abandoned in favor of tracheotomy in 1941 because in our hands it was found to be a relatively ineffective method.

4. Pneumothorax and pneumomediastinum may occur as complications of the respiratory obstruction in croup. More frequently these complications are found after tracheotomy and should be suspected if hypoxia persists or reappears after establishment of an adequate airway. The incidence of these complications can be reduced by performing tracheotomy with a bronchoscope or other tube in situ which provides an adequate airway during surgery.

5. Observation of the principles discussed above, coupled with the use of antibiotics, has resulted in a marked reduction in case fatality and the necessity for tracheotomy in infectious nondiphtheritic croup in the past 10 years at Kingston Avenue Hospital.

NASAL FRACTURES

The Neglected Nose

JAY G. ROBERTS, M.D.
AND
GILBERT J. ROBERTS, M.D.
POMONA, CALIF.

A NASAL fracture was first observed by one of us (J. G. R.) some 50 years ago as a third-year medical student. In the course of a baseball game, a grandstand collapsed; the victim suffered only a broken nose. Imbued with enthusiasm for modern surgical procedure, the student thought immediately of a hospital operating room and aseptic facilities. However, the local country practitioner who immediately assumed charge had other ideas. Removing from his pocket a lead pencil, he proceeded to pass it forcibly up each nostril of the patient; with vice-like thumb and finger he proceeded to mold the nose to his not too discriminating taste while the patient writhed in agony. The technique was not particularly impressive at the time.

While this variety of surgery is, of course, a thing of the past, it is feared that the feeling still prevails that reduction of a nasal fracture is a trifling manipulation without consequence. When we consider the ultimate effects of improperly corrected nasal fractures on respiration, sinus aeration and infection, and hearing and personal appearance, it seems that the subject is entitled to more consideration than is given it in the average textbook on otolaryngology. The repair of nasal fractures presents two different aspects, each perhaps of equal importance to the patient.

Practicing as we do near motion picture studios, we find that the average youthful patient of either sex is most intensely interested in the cosmetic result of our workmanship. Also, our nearness to the ocean, with its fogs and dampness, with abrupt swings of temperature, and the recent addition of smog from industrial plants, leads to an endless prevalence of colds, sinusitis, nasopharyngitis, and other upper respiratory infections and should direct the operator's best efforts toward securing as perfect functioning as conditions will permit.

To this end a clear conception of the anatomy of the nose, together with the relation of cartilaginous parts to the bony structure and the restoration of this relationship, is essential. Therefore, before we proceed to a suggested technique, a brief consideration of the anatomy of the nose may refresh the memory.

As stated, the framework of the nose is made up of a bony and a cartilaginous part. The bony portion consists of the two nasal bones joined together in the midline and articulating with the nasal process of the frontal bone by a serrated border, with the maxillae laterally joining them, thus to form the bony arch or bridge of the nose.

The strongest part of this bony structure is its attachment to the frontal bone above, while the most fragile part, and the most frequently fractured with ensuing displacement, is the free margin of these bones inferiorly, together with their attachment to the maxillae.

The lower and most prominent part of the nasal structure is formed by a group of cartilages. The septal, or quadrangular, cartilage, together with the bony plate of the ethmoid, resting in a groove in the vomer on the floor of the nose, divides the nasal cavity into two separate chambers and also serves as a ridgepole maintaining the symmetrical outline of the organ. Any perpendicular or lateral displacement of this outline gives rise to cosmetic disfigurement, frequently of more importance to the patient than any functional inconvenience caused by obstruction to breathing, aeration, and drainage of the affected side.

The lateral cartilages forming the outer walls of the lower nose are loosely attached to the lower border of the nasal bones by fibrous tissue and are not very firmly attached to the dorsal border of the septum. Thus attached, they act as guy

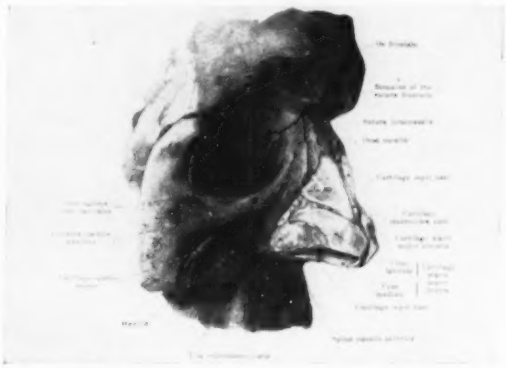

Fig. 1.—Bones and cartilages of the nose (from Spalteholz' Hand Atlas of Anatomy, Philadelphia, J. B. Lippincott Company, p. 830).

ropes on the septal ridge, holding it in midline. Any trauma to the septum may result in a tearing of this fibrous attachment, thus lengthening one guy rope and allowing the ridge to swing to one side or the other, resulting in unsightly deformity.

A frequent occurrence is displacement of the septal cartilage from its groove in the vomer, causing obstruction to breathing, depression of the tip, and sagging and lateral displacement of the nasal dorsum. This is a frequent occurrence in early childhood resulting from injuries in falling, blows on the nose, and even trauma at birth.

If detected immediately this condition may be corrected with thumb and finger, or if more time has elapsed by the use of a small Asch or similar nasal forceps, preferably with the use of an evanescent anesthetic agent, such as vinyl ether (vinethene®) or ethyl chloride.

In approaching the problem of the repair of fractures in adults, the otolaryngologist should follow a carefully planned technique. The final results of his handiwork are sufficiently important to make unwarranted any hurried and unstudied effort at immediate reduction.

A careful diagnosis of the presenting conditions should be made before proceeding to the repair of the damage, and this cannot be done with certainty until anesthesia has been effected. One of us (G. J. R.) has worked out a method of local anesthesia which has proved eminently satisfactory. It is herewith described.

The mucous membranes are sprayed with a mixture of epinephrine hydrochloride and 10% cocaine (a procedure not entirely free from danger, since a few persons possess a susceptibility to very small amounts of both of these drugs and there is always a chance of swallowing some amount). Intranasal anesthesia is completed by blocking the sphenopalatine and anterior nasal nerves by cocaine and on cotton-tipped applicators.

All blood clots and secretions are removed by spot suction until a clear view of the field is obtained; the septum is then carefully inspected for swelling and hematoma suggesting a recent deformity rather than an old injury. The necessity for a reduction having been determined, external anesthesia by a 2% procaine nerve block follows.

A small wheal is produced with a 26-gauge needle, 1 cm. above the inner canthus on each side. This is then replaced by a 22-gauge needle with a short bevel, which will minimize the chance of puncturing a vessel and causing a pronounced hematoma, which, while of no importance, may be rather startling to the patient. This needle is inserted to a depth of 2 cm. along the orbital wall, where 1 cc. of the solution is injected. This anesthetizes the supratrochlear and infratrochlear nerves, which supply the upper part of the external nose, and also the anterior ethmoid nerve, which supplies the anterior superior portion of the septum. The infraorbital nerves are blocked by similar wheals lateral to the ala nasi, followed by injection into each infraorbital foramen of a similar amount of the procaine solution. This anesthetizes the lower part of the external nose. This technique avoids infiltrating the tissues overlying the framework of the nose, preserving an undistorted field.

Fig. 2.—Block anesthesia (from Labat, G.: Regional Anesthesia, Philadelphia, W. B. Saunders Company).

While this technique may be quite satisfactory in most adolescents and adults, in children and many neurotic adults it may be necessary to resort to one of the milder general anesthetics, such as vinyl ether or ethyl chloride, or even to intravenous anesthesia. Satisfactory anesthesia having been attained, one proceeds unhurriedly by means of a blunt Killian submucous elevator and an Asch or Walsham forceps to unlock broken bones and realign the septum. All manipulations should be carefully and painstakingly carried out, with as little trauma as possible, until the original contour of the nose, both internal and external, has been regained. The septum should by means of the forceps be replaced in its groove, after which the bony arch should be restored by the combined use of the elevator within and the finger and thumb without.

After a satisfactory result has been obtained both cosmetically and functionally, the nose should be splinted both internally and externally.

For inside splints foam-rubber material such as can be found in the form of powder puffs obtainable in any 10-cent store will be found most excellent. They may be sterilized by boiling and when cut in two require very little additional shaping to fit high in the nasal vault. Folded or rolled they can be inserted through the anterior nares, where they at once spring into shape, filling the nasal cavity much more satisfactorily than Simpson splints, and exerting a smooth, even pressure not obtainable with any other splinting material.

The external splint should control swelling and hematoma, while holding bony fragments and torn cartilages in place until their position is well fixed. Sheet lead and copper have long been used to form external splints, but are difficult to fashion so that they conform to the external surface of the nose without exerting uncomfortable and harmful pressure on some parts of the organ.

A plaster spica can be built up to conform perfectly without undue pressure to any part of the nose. A few drops of liquid petrolatum applied to the eyes will protect them from

Fig. 3.—Plaster spica for external fixation.

any loose powdered plaster. A cotton flannel butterfly is fashioned to fit the nose, forehead, and cheeks and is held in place with touches of some adhesive paste. Then strips ½ (1.27 cm.) to 1 in. (2.54 cm.) in width of "Specialist" plaster bandage soaked lightly are applied layer upon layer longitudinally and transversally until a firm, sufficiently heavy cast is built up. This is allowed to dry, which happens rather quickly, and is then strapped snugly in place with adhesive strips across forehead and cheeks.

As a final precautionary measure 300,000 units of penicillin procaine is administered daily until the packing is removed; and since the occurrence of a death from tetanus in a local hospital following a rather trivial wound of the skin in a nasal fracture, we are inclined to believe that an injection of tetanus antitoxin should also follow.

The packing may be removed in four days. Since using penicillin we seldom incur any foulness of the pack in that time. The external splint should be allowed to remain for a week to 10 days for safety.

1708 N. Garry Ave.

OSTEOGENIC SARCOMA METASTATIC TO THE NASAL MUCOSA

A. F. JUDGE, M.D.
MARTINSBURG, W. VA.

OSTEOGENIC sarcomas are those in which the tumor parenchyma displays recognizable differentiation of bone or osteoid tissue. They occur most frequently in men in the 10 to 30-year age group. The primary site in 65% of cases is in the lower limbs near the ends of the bones where growth momentum is greatest. Injury has been regarded as a cause of osteosarcoma, but the evidence is inconclusive. Microscopically, the appearance ranges from fully differentiated bone to anaplastic spindle cells devoid of recognizable osteoblastic differentiation. Willis [1] states that metastases to the lungs appear in a large proportion of cases. They may also appear in the skin, liver, brain, and other bones. Lees [2] in 1947 reported the first case of osteosarcoma metastatic to the choroid. Review of the literature for the past 17 years fails to reveal any case metastatic to the regions covered in the field of otorhinolaryngology. For this reason the following case is being recorded.

REPORT OF A CASE

History.—A. S., an 18-year-old, white male veteran, was admitted to the hospital on July 2, 1951, complaining of shortness of breath, cough, and hemoptysis of several weeks' duration. On Sept. 21, 1950, at the Great Lakes Naval Hospital in Illinois, the patient had an amputation above the knee of the left leg for osteogenic sarcoma of the left tibia. On May 22, 1951, the patient was seen in the Out-Patient Clinic of the Veterans Administration Center at Martinsburg for a checkup. A roentgenogram of the chest at that time showed several round shadows in the chest which were sharply defined and varied in size from that of a pea to that of a nut. The right mediastinum was widened at that time. The indication was pulmonary metastases from osteogenic sarcoma of the left tibia. A roentgenogram of the stump of the thigh at that time showed no evidence of tumor in that region.

Physical Examination.—The patient was a well-developed, well-nourished, white male veteran with an above-knee amputation on the left. There was some old blood present in his left nostril. There were painless subcutaneous nodules present in the region of the umbilicus, left axilla, and right hip. The tonsil fossae were clean. There was some increased resonance in the right upper chest posteriorly. There were a few moist rales present at the bases. The remainder of the physical examination showed no abnormality.

Laboratory Examination.—A hemogram showed a white cell count of 10,850 with 70% polymorphonuclear leucocytes. The red cell count was 4,140,000 with a hemoglobin content of 12.5 gm. Urinalysis was normal. The Kahn test gave a negative reaction for syphilis. A chest

From the Department of Otolaryngology, Veterans Administration Center, Martinsburg, W. Va.

Reviewed in the Veterans Administration and published with the approval of the Chief Medical Director. The statements and conclusions published by the author are the result of his own study and do not necessarily reflect the opinion or policy of the Veterans Administration.

1. Willis, R. A.: Pathology of Tumours, London, Butterworth & Co., Ltd., 1948.

2. Lees, V. T.: A Case of Metastatic Osteosarcoma in Choroid, Brit. J. Ophth. **31**:713 (Dec.) 1947.

roentgenogram at that time showed that the metastatic areas were larger than on the previous examination. There were also new metastatic areas present in the first left anterior interspace. There was evidence of pleural effusion at the right base and also at the left base. Roentgenograms of the skull, spine, and pelvis failed to show any evidence of malignant metastases.

Course in Hospital.—During the hospital stay the patient was given general supportive treatment. He continued to have blood-tinged sputum and some chest pain. In addition, he had intermittent bleeding from the left side of the nose. By July 12, 1951, the red cell count had fallen to 3,100,000 red cells, and the hemoglobin was 10 gm. Transfusion with whole blood at this time raised the red cell count to 4,140,000 and the hemoglobin to 12.5 gm. Pain was controlled by codeine and meperidine (demerol®) hydrochloride and in addition the patient received "synkayvite" and intravenous fluids. The patient was seen in the Ear, Nose, and Throat Clinic on July 19, 1951, because of the epistaxis from the left nares. Examination following removal of an old blood clot from the left side of the nose revealed a tumor mass involving the mucosa of the left inferior turbinate, which was red in appearance and bled easily on manipulation. The bleeding was controlled by absorbable gelatin sponge ("gelfoam") and petrolatum gauze packing. In spite of the supportive therapy, the patient's course was rapidly downhill, and he was placed in an oxygen tent on July 22, 1951. The patient died on July 23, 1951. Postmortem examination was performed.

High-power photomicrograph of nasal mucosa showing ciliated nasal epithelium and masses of poorly differentiated tumor cells in submucosa (× 187).

The clinical diagnosis was generalized metastases secondary to osteogenic sarcoma of the left tibia. The tumor mass in the left side of the nose was regarded as a metastatic lesion.

Postmortem Examination.—Postmortem examination showed the presence of metastatic tumor masses in the lungs, heart, liver, spleen, kidney, adrenal glands, brain, small intestine, diaphragm, left inferior nasal turbinate, and the subcutaneous tissue of the chest wall. In addition, the lungs showed pneumonitis and bronchiectasis.

Microscopic examination of sections of lung showed areas of well-differentiated tumor composed of cells of various sizes and shapes, including many giant cells. There was a well-defined osteoid matrix present in some sections.

Examination of sections of nasal mucosa showed masses of tumor tissue which were poorly differentiated and variable in cellular pattern, and numerous atypical mitoses.

Pathological diagnoses were (1) osteogenic sarcoma with metastases to the above-mentioned organs; (2) bronchiectasis; and (3) bronchopneumonia.

COMMENT

The necessity of considering metastatic tumors in ear, nose, and throat diagnosis was forcibly brought to my attention in 1946. At that time I was called to treat a patient with all the signs of an advanced malignancy of the right antrum. That was his initial diagnosis. Subsequent examinations disclosed that the patient had a Pancoast tumor of the right lung with a metastatic lesion in the right maxilla. The antrum itself was unaffected.

In the case presently under discussion, the presumptive diagnosis of metastatic lesion in the nose was made because of the known metastases to the lung and chest wall. Biopsy was not performed because of the necessity of arresting the epistaxis. Subsequent postmortem examination of the tissue from the bleeding area showed that the presumptive diagnosis was correct.

Ward and Hendrick [3] emphasize the importance of metastatic lesions in the eye and orbit in the differential diagnosis of diseases in that region. However, in their discussion of tumors of the nose and sinuses no mention is made of metastatic disease. They state that they have seen only six primary malignant lesions of the nasal mucosa.

Frazell and Duffy [4] in a recent review of 40 cases of cancer of the thyroid reported two cases in which metastases to the nasal cavity had occurred.

SUMMARY

1. A case of osteogenic sarcoma metastatic to the nasal mucosa of the left inferior turbinate has been described.

2. The suggestion is made that, although extremely rare, metastatic lesions be considered in the differential diagnosis of tumors of the nose.

Veterans Administration Center.

3. Ward, G. E., and Hendrick, J. W.: Diagnosis and Treatment of Tumors of the Head and Neck, Not Including the Central Nervous System, Baltimore, Williams & Wilkins Company, 1950.

4. Frazell, E. L., and Duffy, B. J., Jr.: Hürthle-Cell Cancer of the Thyroid: A Review of 40 Cases, Cancer **5**:952-956 (Sept.) 1951.

FERROMAGNETIC FOREIGN BODIES BEYOND THE PYLORUS

A Report of Two Cases in Which Successful Peroral Removal Was Accomplished by Use of the Alnico Magnet

ALFRED A. DORENBUSCH, M.D.
CHARLOTTE, N. C.

IN RECENT years considerable enthusiasm has been aroused concerning the use of the Alnico magnet for peroral removal of magnetic foreign bodies from air and food passages.[1] The usefulness of the magnet has been well demonstrated in other clinics as well as in the Charlotte Eye, Ear and Throat Hospital.[2] However, the endoscopic use of forceps is at times a useful adjunct to magnetic foreign body extraction. This is particularly true of large objects which pull away from the magnet at the level of the cricopharyngeal muscle.

In my experience the magnet has been of limited value in the airway. Indeed, I have used it only for removal of a small nail beyond bronchoscopic vision, which required roentgenoscopic aid. Nevertheless, the bronchoscopist has heretofore handled this type of problem very satisfactorily with proper forceps.

When a magnetic foreign body is beyond endoscopic vision in the gastrointestinal tract, the true usefulness of the Alnico magnet is apparent. Many problems which heretofore would have posed difficult, if not hazardous, solutions by forceps extraction or surgery now are easily solved with the use of magnetic force.

Equen's reports [3] on the successful removal of magnetic foreign bodies from the duodenum, together with Whalen's recent report,[4] stimulated my own interest in the matter. The fortunate outcome in the cases cited obviated abdominal surgery, which, even with modern antibiotics, is not without fatality.

W. E. Roberts [5] of our clinic has demonstrated the usefulness of swallowing a small amount of a carbonated beverage to outline the stomach roentgenographically

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From the Charlotte Eye, Ear and Throat Hospital.

1. Silber, S.; Kaplan, C., and Epstein, B. S.: The Use of a Permanent (Alnico) Magnet in the Peroral Removal of a Metallic Foreign Body (Padlock) from the Stomach, Ann. Otol. Rhin. & Laryng. **53**:589-594 (Sept.) 1944. Equen, M.: A New Magnet for Foreign Bodies in the Food and Air Passages, J. A. M. A. **127**:87-88 (Jan. 13) 1945. Silber, S., and Epstein, B. S.: The Peroral Removal of Certain Swallowed Foreign Bodies Without Endoscopy, New York J. Med. **47**:1122-1124 (May 15) 1947. Equen, M.: Magnetic Removal of Foreign Bodies from the Food and Air Passages, Arch. Otolaryng. **46**:225-229 (Aug.) 1947.

2. Hart, V. K.: Extraction of Metallic Foreign Bodies from the Food and Air Passages, North Carolina M. J. **8**:637-641 (Oct.) 1947.

3. Equen, M.; Gilliam, R., and Lineback, M.: Nail in Duodenum Removed by Magnet, J. A. M. A. **135**:432 (Oct. 18) 1947; Magnetic Influence in Bronchoscopy, Laryngoscope **58**:726-734 (July) 1948.

4. Whalen, E. J.: Magnet Extraction of Foreign Bodies, Ann. Otol. Rhin. & Laryng. **59**:717-725 (Sept.) 1950.

5. Roberts, W. E.: Carbonated Soft Drinks as a Contrast Medium for the Localization of Magnetic Foreign Bodies in the Abdominal Visceral Cavity, Laryngoscope **58**:155-161 (Feb.) 1948.

with the resulting liberated gas. In both of the cases cited, this procedure helped determine that the foreign body was beyond the pylorus. Obviously, this saved time and effort by eliminating an unnecessary insertion of the Alnico stomach magnet.

REPORT OF CASES

CASE 1.—This involved a hatpin in the duodenum. T. F. H., a 13-year-old white girl, was seen by me on April 30, 1951, 24 hours after she had swallowed the foreign body. A duplicate of the pin was magnetic and measured approximately 6 cm. in length. Roentgen ray studies revealed the foreign body to be in the duodenum. This conclusion followed the outlining of the stomach with liberated gas (Fig. 1). Repeated roentgenograms daily from May 1 to May 4, 1951 revealed the pin to be in essentially the same position (Fig. 2*A*). The patient had been admin-

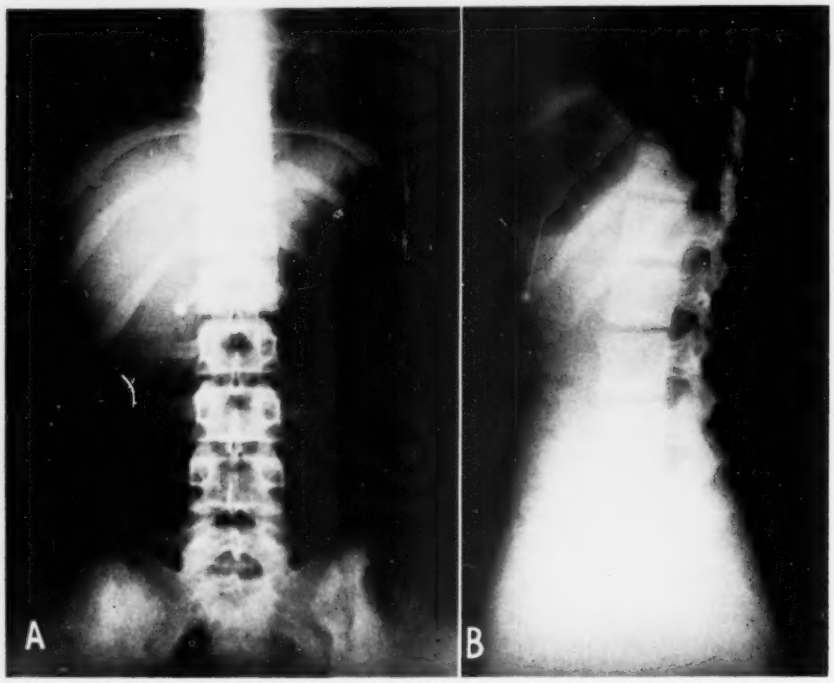


Fig. 1 (Case 1).—*A*, posteroanterior roentgenogram showing hatpin outside the stomach (outlined with gas); *B*, lateral film (note gas outlining the stomach).

istered prophylactic penicillin every other day and aureomycin, 250 mg., every sixth hour. She had no alarming symptoms. On May 4 it was decided to attempt removal of the pin by means of the Alnico magnet. A 3.5 cm. curved magnet was attached to the distal end of a Cantor tube. It was passed into the stomach but did not enter the duodenum in 12 hours (Fig. 2*B*). It was felt that there were too many coils of tubing in the stomach, and so some of the slack was taken up. On May 7 the magnet entered the duodenum and caught up with the pin (Fig. 3). Under fluoroscopic guidance and without anesthesia the pin and magnet were drawn up through the stomach into the esophagus. Upon reaching the cricopharyngeal opening, the pin slipped off the magnet. Several more attempts to bring the magnet with the attached pin from the stomach repeatedly resulted in the pin's slipping off at the cricopharyngeus. It was, therefore, decided to anesthetize the patient with ether. After relaxation was obtained, the pin was pulled up through

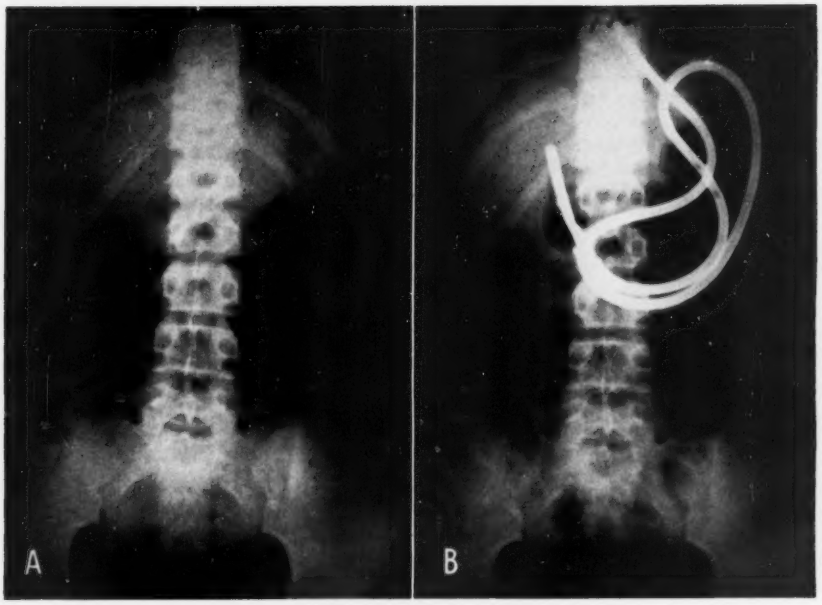


Fig. 2 (Case 1).—*A*, pin in same position. Rugae of stomach are clearly seen. *B*, magnet attached to Cantor tube coiled in the stomach.

Fig. 3 (Case 1).—Magnet and pin attached in the duodenum.

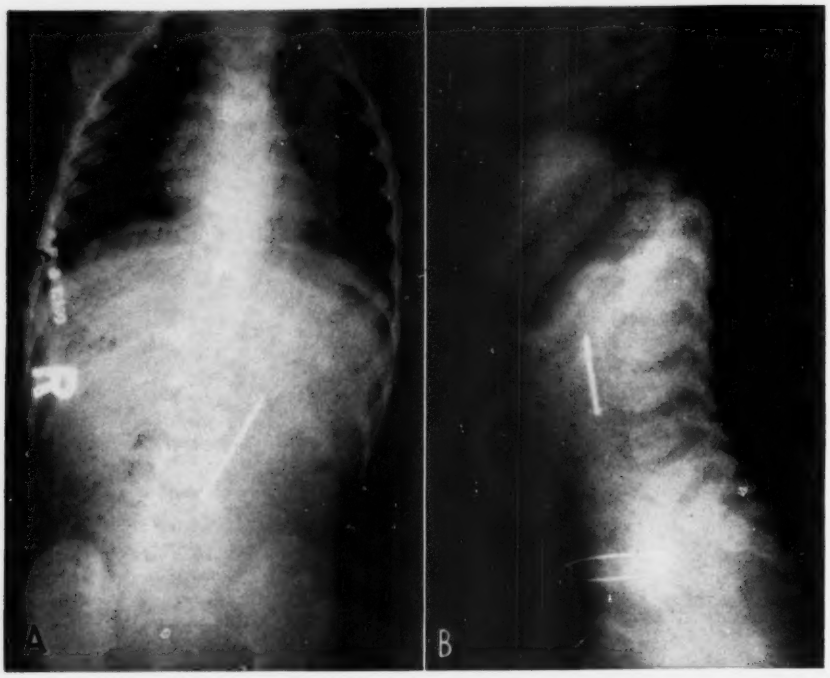


Fig. 4 (Case 2).—*A*, nail somewhere in the gastrointestinal tract; stomach not outlined with gas. *B*, lateral film showing nail outside the stomach (outlined with gas following ingestion of coca-cola®).

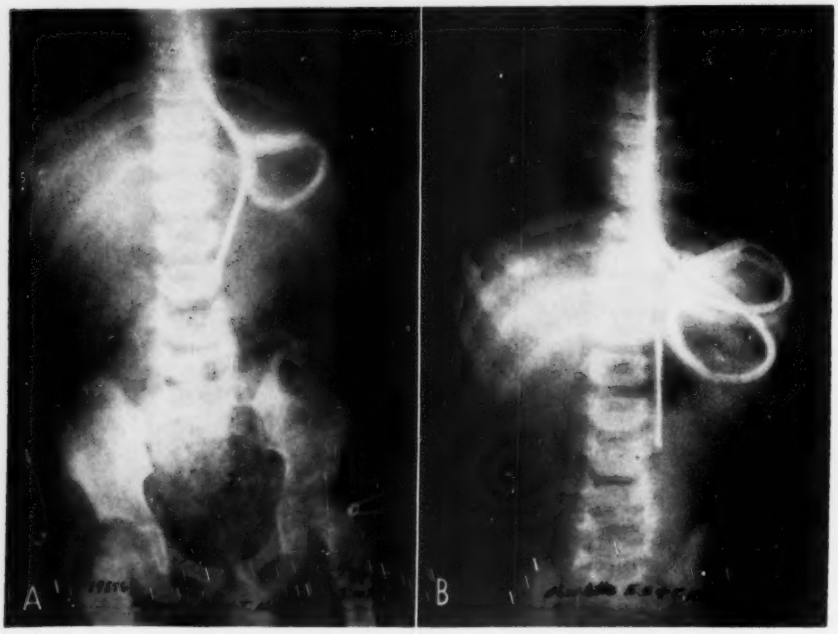


Fig. 5 (Case 2).—*A*, magnet in the fundus of the stomach; *B*, magnet still in the fundus of the stomach.

Fig. 6 (Case 2).—Magnet making egress from the pylorus.

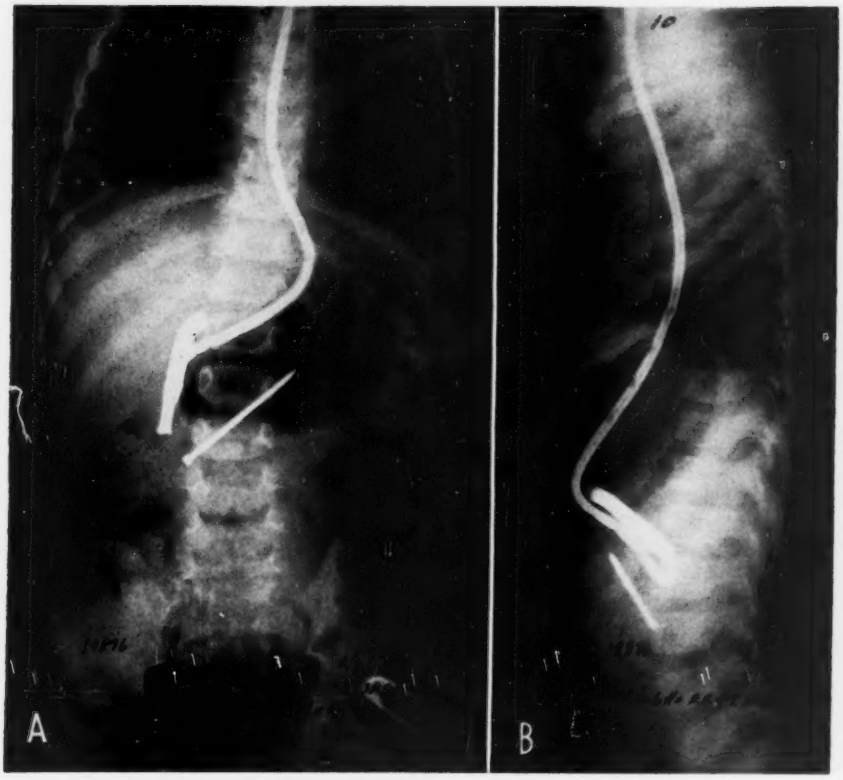


Fig. 7 (Case 2).—Magnet in the superior portion of the duodenum. *A*, posteroanterior view; *B*, lateral view.

Fig. 8 (Case 2).—Magnet making further progress in the duodenum.

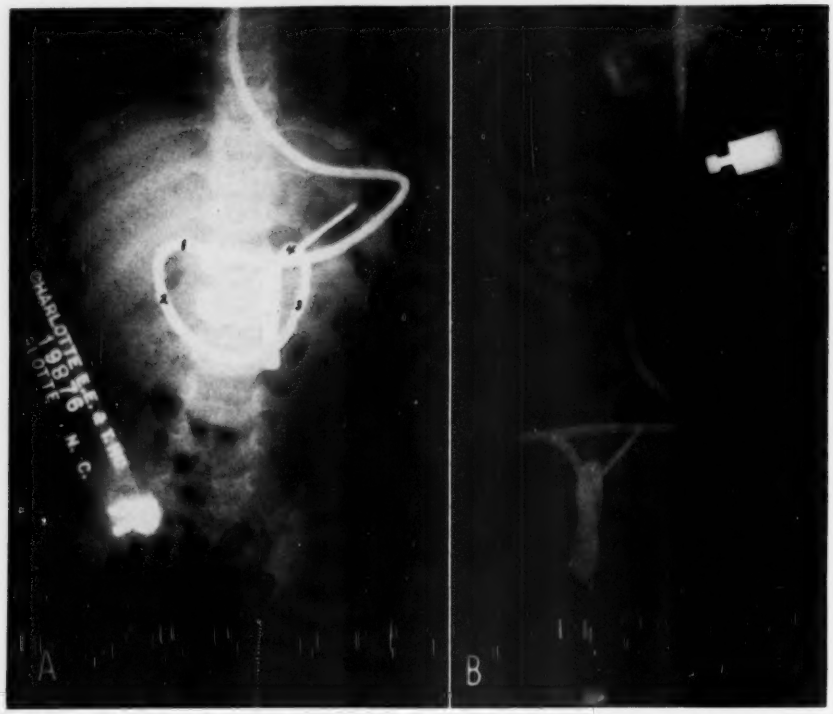


Fig. 9 (Case 2).—*A*, magnet entering the jejunum but still not in contact with the nail as evidenced by lack of alignment: *1*, superior portion of duodenum; *2*, descending portion of duodenum; *3*, ascending portion of duodenum; *4*, duodenojejunal flexure. *B*, lateral view.

the cricopharyngeal opening into the pharynx. A laryngoscope was passed and the pin seized with alligator forceps. It was extracted in this manner without difficulty. The patient made an uneventful recovery and was dismissed on the following day in good condition.

CASE 2.—The foreign body was a six-penny finishing nail in the jejunum. D. M., a 26-month-old white boy, was referred to me on Nov. 7, 1951 with the history of having swallowed a nail four days previously. The referring physician originally believed that it would pass through the intestinal tract normally, but there had been no change in the position of the nail since first observation. The duplicate submitted by the parents revealed that the foreign body was a magnetic nail measuring 5 cm. in length. After posteroanterior and lateral roentgenograms were taken, particularly after the stomach was inflated with gas after the ingestion of a small amount of coca-cola,* it seemed obvious that the nail was impacted in an area outside the stomach (Fig. 4). I therefore saw no need for introducing a stomach magnet. The child was a relative of a local surgeon. Both the surgeon and the family were inclined to have an abdominal section done. However, I prevailed upon them to let me try magnetic extraction first.

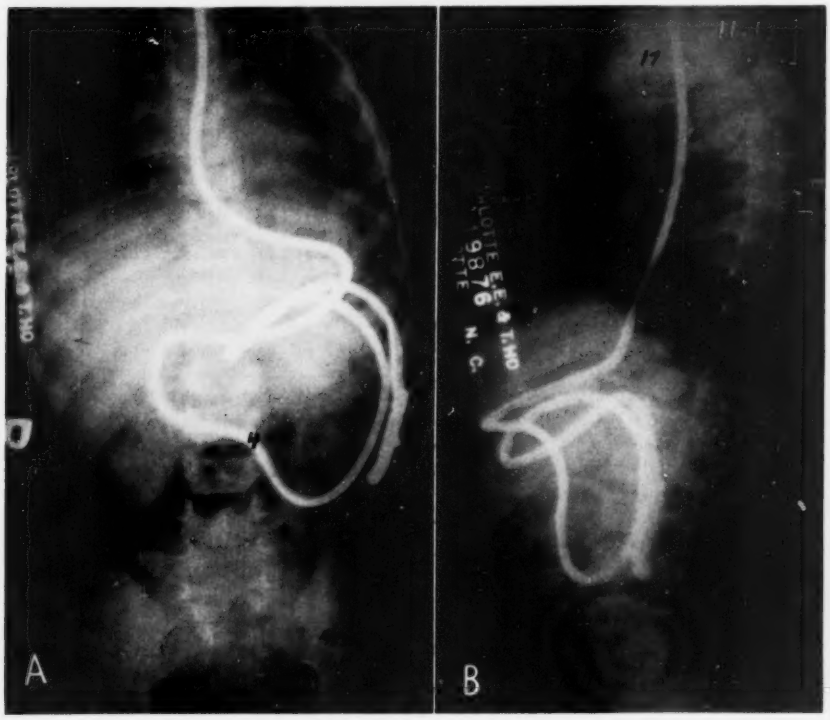


Fig. 10 (Case 2).—*A*, contact of magnet and nail in the jejunum as shown by alignment; posteroanterior roentgenogram. *B*, contact illustrated on lateral roentgenogram.

On the same afternoon of admission a 3.5 cm. curved Alnico magnet, which had previously been secured to the distal end of a child-size Cantor tube, was passed into the stomach in the following manner: The child was taken to the roentgenoscopic room and, without anesthesia, the proximal end of the Cantor tube was drawn out through the right nostril, after first being secured to a nasal catheter in the pharynx. The full length of the tube was drawn up through the nostril, and with a laryngoscope the opening to the upper esophagus was exposed. By means of alligator forceps the magnet was placed in the esophagus and then pushed on down by digital manipulation from above. A film was then made showing the magnet to be in the fundus of the

stomach (Fig. 5*A*). At 11:15 p. m. the same day a roentgenogram showed the magnet still in the fundus of the stomach (Fig. 5*B*). Some slack in the tubing was pulled upward. The nail had not moved. The following day, Nov. 8, 1951, the magnet was still in the fundus of the stomach. The child had been receiving fluids by tube feeding through the same Cantor tube. Since the magnet was not moving appreciably from the fundus of the stomach, I thought that I might facilitate its egress by giving the baby 1 oz. (30 cc.) of coca-cola.® This he readily took by swallowing around the tube. At 2:00 p. m. on Nov. 8 the magnet had moved from the fundus through the pylorus (Fig. 6).

It should be noted that during the first 24 hours I had kept the patient restrained and flat in bed. I believed that the magnet could be dislodged from the fundus by removing the leg restraints and allowing the mother to hold the baby upright, keeping on the arm restraints. This evidently had something to do with the passing of the magnet toward the pylorus. At 2:30 p. m. the magnet had made progress into the duodenum (Fig. 7). At 4:30 p. m. the magnet was seen to be definitely making progress through the turns of the duodenum, but it had not yet caught up with the nail (Fig. 8). At 8:00 p. m. another film revealed the magnet still not in contact with the nail (Fig. 9). This was disappointing because I believed that the magnet had made its exit from the duodenum; even so, it had not reached the nail.

This could mean only that the nail was lodged somewhere beyond the duodenum. On the assumption that the nail was still in the upper jejunum, I allowed more slack by passing approximately 12 cm. of tubing down into the stomach. At 11:15 p. m. the same day, further roentgen ray studies revealed that I had not only caught up with the nail, but that the magnet and nail had moved beyond the original place of lodgment (Fig. 10). I knew that they were somewhere in the jejunum because of the serial roentgen ray studies. Furthermore, calibrated measurements on the tubing clearly indicated that they were well beyond the duodenum.

At approximately 12:00 M. Nov. 8, the baby was lightly anesthetized with ether. Under roentgenoscopic guidance the tubing was gently and slowly pulled up through the nose. It was surprising how easily the magnet and attached nail could be pulled upward through the various turns of the gut. After I had reached the point just below the cricopharyngeus, roentgenoscopy was stopped and the room illuminated. The magnet and attached nail were drawn into the pharynx. With a Jennings mouth gag in position, using indirect lighting, the nail was picked up with a hemostat and removed from the mouth. The magnet was then removed from the mouth and detached from the tubing, and the tubing pulled out through the nose.

The patient was returned to the room in good condition. There was at no time any vomiting, and recovery was prompt. The child had no further difficulty and ate a healthy breakfast the following morning, Nov. 9, 1951.

SUMMARY

Case 1 illustrated the feasibility and facility of removing a magnetic foreign body perorally from an organ otherwise difficult to approach surgically, i. e., the duodenum. Moreover, the use of this method is without fatality; this cannot be said for the direct surgical approach to the problem.

Case 2, to my knowledge, represents the first magnetic foreign body to be removed perorally from the jejunum. At first consideration I was skeptical about using the magnet in the more distant portions of the intestinal tract. However, the ease with which the magnet and attached nail could be withdrawn has completely overcome any former fears that the object might slip off while traversing the turns of the small intestine.

Case 1, the duodenal foreign body, suggested the possible solution to case 2, the jejunal foreign body. Perhaps case 2 suggests the possible solution to removal of magnetic foreign bodies in even more distant intestinal areas.

106 W. Seventh St.

QUANTITATIVE DETERMINATION OF HEARING TO AUDIOMETRIC FREQUENCIES IN THE ELECTROENCEPHALOGRAM

A Preliminary Report

SIDNEY H. GIDOLL, M.D.
SAN FRANCISCO

THE DETERMINATION of hearing loss in children under the age of 5 has invariably posed a problem to the otologist. Tests utilized have mainly been on a qualitative basis with usually a presumptive conclusion, at best, that the child does or does not hear. The stimulus to the sense organ of hearing has varied from percussive sounds in the very young child, which might produce a reflex blink, jump, or twitch, to the "learned" response to the spoken word in the older child, who might turn his head in the direction of sound.

Objective methods of determining threshold hearing acuity, without the cooperation of the patient, have recently been reported in the literature and ably summarized by Utley.[1] These attempts have met with varying results and will be briefly touched upon in this preliminary report.

Utilizing a Western Electric 2 A (battery-operated) audiometer as a pure-tone stimulus for testing, Doerfler[2] concluded that "the encephalographic results often did not yield a threshold measure which could be reliably interpreted." He stated that the encephalographic records were too complex and required too extensive an analysis. He therefore considered the encephalograph and galvanic skin response techniques most suitable for his purpose. His subjects, however, were not consistent in their responses.

Michels and Randt,[3] in a series of tests, utilized a Maico audiometer as the source of sound stimuli and the galvanic skin response, with the aid of an encephalograph, as an objective method in determining auditory acuity. Their best results were obtained with tonal frequencies of 1,024 and 2,048 with the attenuator above 60 db. Below the 50-db. setting poor responses were obtained, and tonal frequencies above 2,048 and below 128 gave feeble galvanic skin reflexes.

Bordley, Hardy, and Richter,[4] in investigating objectively the hearing threshold of infants and young children, utilized the audiometer as the stimulus and recorded the skin-resistance response in the form of a wave record. They plotted the pure-tone thresholds over the entire auditory range on the audiogram. According to

1. Utley, J.: Suggestive Procedures for Determining Auditory Acuity in Very Young Acoustically Handicapped Children, Eye, Ear, Nose & Throat Month. **28**:590 (Dec.) 1949.

2. Doerfler, L. G.: Neurophysiological Clues to Auditory Acuity, J. Speech & Hearing Disorders **13**:227 (Sept.) 1948.

3. Michels, M. W., and Randt, C. T.: Galvanic Skin Response in the Differential Diagnosis of Deafness, Arch. Otolaryng. **45**:302 (March) 1947.

4. Bordley, J. S.; Hardy, W. G., and Richter, C. P.: Audiometry with the Use of Galvanic Skin-Resistance Response, Bull. Johns Hopkins Hosp. **82**:569 (May) 1948; cited by Utley.[1]

Utley,[4] however, these authors provide no information as to their experimental technique or to the age range of the subjects used.

All the preceding tests are predicated on the basis that activity of the sympathetic nervous system may be recorded in response to acoustic stimuli. The galvanic skin response was used by Redlich[5] as an objective method because "a galvanic skin response cannot be elicited if the sensory pathway of the galvanic skin reflex is interrupted by a complete anatomical or physiological disruption of the peripheral nerve." The electroencephalograph was deemed suitable to register "the bioelectric changes accompanying sweat gland and vascular activities characteristic of a normally functioning sympathetic system which manifested itself in the galvanic skin response."

In 1949, Marcus, Gibbs, and Gibbs[6] attempted to determine threshold auditory acuity objectively in young children (while under ordinary and barbiturate-induced sleep) by eliciting the arousal response to audiometric stimulation in the electroencephalogram. This method was not found to be satisfactory because of interference of the electrical circuit of their audiometer with that of the electroencephalograph.

In a later report Marcus[7] states, in discussing the method of utilizing electroencephalographic response to audiometric stimuli for determining auditory acuity, that "during sleep, after any sensory stimulation, the brain wave rhythm changed from a 'sleep' to a 'waking' pattern. This nonspecific arousal response is used as a criterion of cerebral perception of sound. It is not a quantitative measurement in the strict sense but is, rather, an objective indication of whether or not sound is heard. It is possible, of course, to note the extent of the arousal response as compared to the intensity of the auditory stimulus. For the purpose of this study, however, it was desired to know whether a child did or did not hear." Here again, as in 1949, "calibration of the sound intensity had been planned, but several technical problems have not as yet been overcome, i. e., the effect of another electrical circuit on the delicate one of the electroencephalograph."

For this reason, therefore, Marcus was unable to determine the threshold hearing of his subjects by using the audiometer as the source of controlled sound and the arousal response in the electroencephalogram as the criterion of cerebral perception of sound.

REPORT OF A CASE

This determination of threshold auditory acuity was of paramount interest when a male infant of 18 months was presented, with a history of impaired hearing since birth. His parents (31 and 27 years old respectively) each had normal hearing, and there was no history of consanguinity. Since polydactylism in family history has been noted by previous writers as a possible factor in inheritance in congenital deafness, it may be of academic interest only (because of the remote relationship) to note that the patient's maternal granduncle has such a condition.

The patient has two normally developed brothers, aged 5 and 3½ years. Birth was at full term, under caudal anesthesia, and was not instrumental. His developmental history, outside of hearing and speech, was well within normal limits. Impaired hearing was first noticed at the

5. Redlich, F. C.: Organic and Hysterical Anesthesia: A Method of Differential Diagnosis with the Aid of the Galvanic Skin Response, Am. J. Psychiat. **102**:138 (Nov.) 1945.

6. Marcus, R. E.; Gibbs, E. L., and Gibbs, F. A.: Electroencephalography in Diagnosis of Hearing Loss in the Very Young Child, Dis. Nerv. System **10**:170 (June) 1949.

7. Marcus, R. E.: Hearing and Speech Problems in Children, A. M. A. Arch. Otolaryng. **53**:134 (Feb.) 1951.

age of 5 months, because he did not recognize words; and at the present time, according to his mother, he does not recognize sounds or their implication. At the age of 11 months he did say "mama" and "ba-ba" for "bye-bye," but has added no words since then. There is still enuresis and the mother compares his developmental progress in hearing, speech, etc., with the standard set by his two brothers.

The history of previous illness is essentially negative, but several months ago he had an isolated spell of "night terror." The medical and pediatric examination disclosed nothing of significance, and all indicated laboratory tests were within normal limits. Results of ear, nose, and throat examinations were negative; the drum membranes were intact, movable by otoscope, and normal in appearance. The tonsils were small and submerged; the nose and the nasopharynx were clear.

The usual qualitative tests for hearing for a child of this age were nonproductive in results. Clapping the hands behind the child's head did not cause a reflex blink or cause him to jump, and he did not turn his head in the direction of the sound or voice. We know that a child not responding with his eyes and head to the sound of a voice at the end of 12 months is either seriously deaf or has some other gross defect. Normally, by the age of 3 months, he should reflexly blink, jump, or twitch at a percussive sound; by 6 months, he should turn his head in the direction of the sound; and by 18 months, he should respond to the quiet spoken word.

But the fact that the patient could utter words like "mama" and "ba-ba" indicated the presence of the power of hearing, since we learn to speak by reproducing the sounds that we hear; and even the quality of his cry had inflection. The impairment of hearing in this case was difficult to classify; there was nothing of significance in his inheritance history; there were no malformations; there were no diseases or accidents connected with birth; there were no conditions interfering with proper growth or physical development, and no infections subsequent to birth which might have caused impairment of hearing. The drum membranes in congenitally deaf persons are usually normal, as was evident in this case; while in acquired deafness the appearance of the tympanic membrane is determined by the disease causing the deafness. Turner [8] holds that complete deafness is the exception in congenital deafness, while Holt and Howland [9] similarly state that total deafness is rare among congenitally deaf and that hearing for speech is present to a useful degree in about 25% of cases.

The problem to solve in this case was not whether the child could or could not hear but how much hearing did remain; and if so determined, was it within or outside the speech range? What the parents desired to know was the prognosis of the child's hearing. What the otologist desired was a quantitative record of the child's hearing not only to determine the percentage loss of hearing but also to acquire a basis for comparison for subsequent tests from time to time to evaluate the progress of the condition.

Quantitative Determination of Threshold Auditory Acuity.—Using a grounded standard audiometer (Maico Model D-5) as the source of calibrated and controlled sound and an eight-channel type electroencephalograph (Grass), I accomplished determination of threshold auditory acuity without interference of electrical circuit of the audiometer with that of the electroencephalograph. With a unilateral cushioned air receiver of the audiometer placed against the ear of the patient (in light barbiturate-induced sleep) and the electrodes of the electroencephalograph attached to his scalp, each tonal frequency in turn was stimulated. The minimal intensity of sound required to produce an arousal response in the electroencephalographic curve was charted on the audiogram as the threshold auditory acuity for that tone.

In this manner, the measure of the amount of increase of intensity of a given frequency above the zero level in order that it may just be heard (i. e., produce a change in the brain wave rhythm on the electroencephalogram from a "sleep" to a "waking" pattern, which has been referred to as the arousal response) gave the measure of the impairment of hearing for that frequency and could be so charted on the audiogram.

The arousal response, as Marcus [7] has stated, is used as a criterion of the cerebral perception of sound and is interpreted as a criterion of the subject's threshold of hearing. Whether or not

8. Turner, A. L.: Diseases of the Nose, Throat and Ear, New York, William Wood & Company, 1924.

9. Holt, L. E., and Howland, J.: Diseases of Infancy and Childhood, ed. 7, New York, D. Appleton & Company, 1920.

the qualitative response to stimulation, as reported heretofore, is nonspecific, probably a sleep phenomenon, does not concern me here. I am more interested in the determination of the threshold of hearing than in the mode of reception.

In view of the response shown on the electroencephalogram, in this case, one might conclude that audiocentral perception is present. Clinically, however, I was already in possession of that information. Analysis of the audiogram (Fig. 1) indicated that the peripheral end-organ, the cochlea, did respond over the entire auditory range but with a loss of from 10 to 40 db. and with a slightly lower acuity on the right than on the left side. Sufficient time was allowed to elapse,

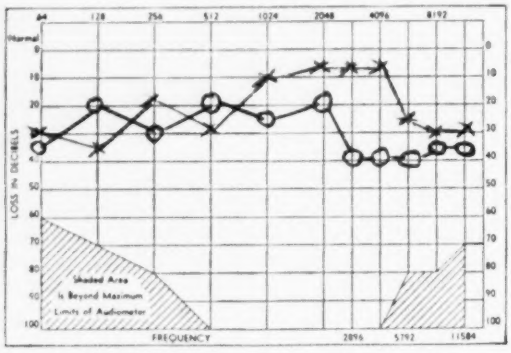


Fig. 1.—Audiogram of 18-month-old patient.

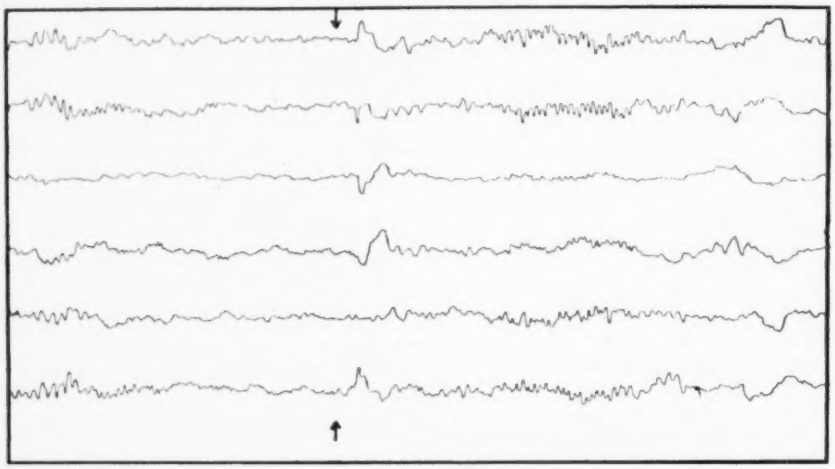


Fig. 2.—EEG study during audiostimulation (indicated by arrow) while patient is sleeping under the influence of a sedative.

each time the arousal response appeared, for the "waking" pattern to subside again into the "sleep" pattern before each successive audiostimulation was initiated.

Analysis (by C. L. Y.[10]) of the electroencephalogram (Fig. 2) is as follows: "The sleeping record showed a medium voltage 5 to 7 cps activity which was often superimposed upon random slow waves below 4 cps.

10. The electroencephalography was performed in the EEG Laboratory, Mount Zion Hospital, San Francisco, and was also interpreted by Dr. Charles L. Yeager, Assistant Professor of Psychiatry, University of California School of Medicine; Director of Electroencephalographic Laboratories, Langley Porter Clinic-Hospital, San Francisco.

"Just subsequent to the threshold audiostimulation an arousal response was observed. It was manifested by large sweeping upward or downward waves with an average duration of 3 seconds followed by a series of 8 cycle waves. After a delay of a second to a second and a half, there was a burst of 14 to 15 cycle waves with increased amplitude. This response occurred more or less uniformly in all areas.

"By means of this response the level of stimulation for a given frequency could be determined and charted.

"Comment: This generalized response is an arousal phenomenon of a nonspecific nature, that is to say, it is not specific for any type of stimulus. However, in this case it served to mark the level of stimulation necessary to alert the cerebral cortex, thereby making it possible to map the levels of hearing throughout the audio range."

SUMMARY

A preliminary report is submitted in order to record a method of procedure by which quantitative measurement of threshold auditory acuity may be determined without patient cooperation.

This was accomplished by using standard audiometer (Maico Model D-5) as the source of calibrated and controlled sound and an eight-channel type electroencephalograph (Grass) as the index of arousal response.

Interference of the electrical circuit of the audiometer with that of the electroencephalograph was avoided by means of grounding the audiometer.

516 Sutter Street.

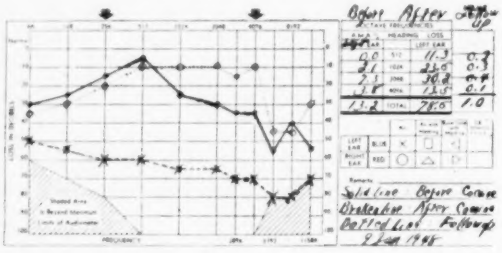
Case Reports

ANESTHESIA OF INTERNAL EAR FOLLOWING APPLICATION OF TOPICAL ANESTHETIC TO MIDDLE EAR

FRANK B. VANDERBEEK, M.D.
PATERSON, N. J.

IN THE treatment of patients with a perforated drum membrane, it is customary to apply a moderately caustic solution, such as 10% silver nitrate, by means of a cotton-tipped applicator to the edge of the perforation. It happens occasionally that some patients experience severe pain following this treatment. To render this treatment tolerable to such patients, it has been my custom to apply to the perforation a pledget of cotton moistened with a topical anesthetic prior to the application of silver nitrate. Two of the patients so treated have experienced transitory anesthesia of the internal ear. One experienced deafness; the other, vertigo. The case reports follow:

CASE 1.—J. B. M., a 20-year-old white youth, was under treatment for bilateral otitis externa in July and Aug., 1947. During the course of treatment, the canal and drum of the left



Audiogram showing results of application of topical anesthetic to middle ear.

ear became more inflamed and congested, and on Aug. 29 a perforation of the drum membrane was found. Subsequent events led strongly to the belief that this secondary inflammation was due to a sensitivity to metacresylacetate (cresatine®) which had been used in the treatment. I have never previously, nor have I since then, observed a perforation of the drum membrane which resulted from inflammation of the external ear without trauma.

On Aug. 29, the perforation was touched with 10% silver nitrate. This caused severe pain, persisting all night. So at the next visit, on Sept. 5, a pledget moistened with 10% cocaine was first applied to the perforation. Within minutes the patient complained of deafness in the left ear. Fortunately, an audiogram had been made that evening, prior to any local treatment; another was promptly made. These audiograms, as illustrated, show a drop in hearing, from a loss of 13.2% to a loss of 78.5%, a net loss of 65.3%. On Jan. 9, 1948, well after complete healing of the drum and of the otitis externa, another audiogram was made. It showed a loss of 1.0% of hearing.

CASE 2.—W. S., a 26-year-old white man, was first seen on April 5, 1951. A piece of hot steel had fallen into his left external ear canal. The external canal was badly burned. Although no perforation of the drum membrane was seen, the existence of a perforation was suspected because the membrane failed to move with increased and decreased pressure in Siegle's otoscope. Swelling of the external ear canal prevented examination of the drum in its entirety.

After observation and treatment for one week, the patient failed to return. He was not seen again until June 6. He then had otorrhea and a large central perforation of the left drum membrane. The onset of the discharge had been gradual and painless. The otorrhea was controlled by local treatment and by penicillin procaine parenterally. On Aug. 27, the perforation was touched with 10% silver nitrate; this produced moderate pain, lasting for several hours. On Sept. 7, a 2% solution of dibucaine hydrochloride (nupercaine®) was applied to the perforation. Within a few minutes the patient complained of dizziness. There was present a rotatory nystagmus to the right (destructive disharmony). The pledget was removed, and the patient was allowed to recline. In three and one-half hours he had recovered sufficiently to be taken home. Some dizziness remained, but the nystagmus was no longer present. An audiogram taken just before he left the office showed a loss of 56.8%. Another, taken 10 days later, showed a loss of 50.9%. This is not believed to be a significant difference.

The patient was able to work as usual on the day following the induced attack of vertigo. No further attempt at cauterization of the perforation was made. There has been no recurrence of the otorrhea or of the vertigo.

SUMMARY

Two cases are presented in each of which there was perforation of a drum membrane. In each, a topical anesthetic was applied on a pledget of cotton to the perforation preparatory to its cauterization. In each instance, anesthesia of the internal ear resulted. In the first case the effect was confined to the cochlea; in the second case it was confined to the vestibular apparatus. Recovery in both cases was uneventful.

It is believed that the anesthetic was absorbed by the internal ear by one of three routes: (1) through a possible dehiscence of the bony wall of the labyrinth, (2) through the round window, or (3) through the oval window, around the stapes.

407 Park Ave.

Progress in Otolaryngology

Summaries of the Bibliographic Material Available in the Field of Otolaryngology, 1950

THE PARANASAL SINUSES

SAMUEL SALINGER, M.D.
CHICAGO

(Continued from Page 508)

NONMALIGNANT TUMORS—OSTEOMA

HALLBERG and Begley[62] present a review of 51 cases of osteoma of the sinuses; 36 patients were men and 15 women. The majority were in the middle decades. Forty of the cases involved the frontal, nine the ethmoid and two the maxillary sinuses. The average duration of signs and symptoms at the time of examination was 3.7 years. Several unusual cases are reported. In a man of 28, complaining of severe headaches for several months, amnesia and weakness of one arm developed. Roentgenograms revealed a large frontal osteoma with an encephalocele. Operation disclosed a chronic brain abscess and pneumatocele. It was believed that the presence of air and the infection resulted from penetration of the dura and tip of the frontal lobe by the growing mass, permitting infectious material to enter when the patient coughed or blew his nose.

In another case a huge osteoma involving both frontal sinuses and one ethmoid sinus proved to be the seat of a sarcomatous degeneration.

A third case occurred in a woman of 33, with a dense osteoma filling the right nasal fossa, and right ethmoid labyrinth, with extensions into the sphenoid and antrum. At operation the roof of the orbit was removed, exposing a fistula in the dura from which a profuse flow of pus issued. This was found to lead to a brain abscess. The outcome was fatal, and at autopsy a second abscess was found between the falx cerebri and the frontal lobe.

A case of osteoma in the frontal area is described by Wertheimer and Lecuire.[63] The patient, a healthy man of 24, was suddenly seized with Jacksonian fits of the brachial type. Roentgenograms revealed an extensive bony mass in the anterior fossa which seemed to arise from either frontal or ethmoid sinuses. There were no ocular, auditory, or general neurological findings. The tumor was exposed via an osteoplastic flap in the frontal bone and was removed without damage to the dura. It appeared to have its origin in the ethmoid sinuses. Apparently the tumor was not removed in its entirety, because five months later roentgenograms showed a persistence of the growth at the base, which seemed to be increasing in size. Shortly after, there was recurrence of the Jacksonian episodes with biting of the tongue and involuntary urination. Electroencephalography revealed evidence of a deep-seated neoplasm on the right side. A later tracing seemed to indicate pressure

62. Hallberg, O. E., and Begley, J. W.: Origin and Treatment of Osteomas of the Paranasal Sinuses, Arch. Otolaryng. **51**:750 (May) 1950.

63. Wertheimer, P., and Lecuire, J.: Volumineux ostéome de'origine ethmoidale occupant l'étage antérieur de la base du crâne, Lyon chir. **45**:623 (July) 1950.

in the temporo-occipital region. A ventriculography indicated obstruction in the region of the foramen of Monro. The wound was reopened and extended backward. The mass was found to have extended deeply into the ethmoid sinuses and backward along the base of the fossa. The dura was torn slightly in removal of the growth. Hemorrhage was controlled by a gelatin sponge and thrombin. Penicillin powder and a sulfonamide were insufflated. The bony flap was replaced and a small drain left in. Roentgenograms later showed that the tumor had been entirely removed. Recovery followed.

The authors refer to Cushing, who advised endocranial removal of tumors in this location. Other authors later supported Cushing's proposal. The authors point to the value of encephalography and ventricular puncture in these cases, since these procedures afford information beyond that obtainable from roentgenograms and general neurological examination. The x-ray pictures which illustrate the article are very clear.

King [64] reports five cases of osteoma of the frontal sinus in patients between the ages of 32 and 39, one of whom was a woman. Three patients had frontal headache radiating to the occiput with soreness of the cervical muscles. The diagnosis is usually made by roentgenograms, and surgery is indicated in all cases in which the pictures show erosion of the bony walls of the sinuses or in which symptoms such as pain or distortion are present.

MUCOCELE—POLYPI—CYSTS

Anthony and Williams [65] report a rare case in which an unusually large mucocele involving all of the sinuses on one side presented the appearance of an inoperable malignant growth. This impression was gained from the fact that the fleshy mass seen in the nose extended beyond the boundaries of the sinuses, causing erosion into the orbit and cranial cavity. Roentgenograms showed destruction of the sella turcica and a portion of the sphenoid bone. X-ray treatment was instituted, and a year later there was some evidence of bony regeneration in the floor of the sella. Therefore an operation was undertaken, which disclosed absorption of the paper plate and floor of the ethmoid labyrinth, the entire space being filled with a gummy mucus. The dura was exposed over the entire roof of the sphenoid sinus. Also the bony walls of the antrum were considerably thinned by pressure of the growth, which had extended into the sinus, completely filling it.

Terracol, Guerrier, and Saramito [66] report a case of mucocele of the ethmoid sinus in a child of 13 and comment on the rarity of this condition in children. They believe that mucocele and mucous polyp are of the same origin and present arguments based on the etiology and anatomopathological and clinical features to support their thesis. A mucocele is in essence a mucous polyp developing within the sinus, which fails to exteriorize into the nasal cavity because of a narrow sinus meatus, or one that is obstructed because of previous inflammatory changes.

On the basis of four cases observed in the clinics of the Illinois Eye and Ear Infirmary during the past nine months, in which the diagnosis of mucocele was

64. King, N. E.: Osteoma of the Frontal Sinus, Arch. Otolaryng. **51**:316 (March) 1950.

65. Anthony, W. P., and Williams, H. L.: Unilateral Pansinal Mucocele Simulating a Malignant Neoplasm, A. M. A. Arch. Otolaryng. **53**:189 (Feb.) 1951.

66. Terracol, J.; Guerrier, Y., and Saramito, G.: La mucocèle chez l'enfant, Oto-rhino-laryng. internat. **28**:5 (Jan.) 1950.

made, Tamari and O'Neil [67] briefly review this subject. From a careful study of the pathological material obtained, the authors present what they believe to be a more understandable concept of mucocele formation.

The first case was in a 66-year-old white man with a history of a painless swelling over the left eye of four years' duration. There was marked downward and outward displacement of the left eye with vision of 20/200. A diagnosis of mucocele was confirmed by aspiration and roentgenograms. An external frontal operation was performed and the postoperative course was uneventful.

The second case was in a 25-year-old Negro man who had noted drooping of the left eyelid and eye for a year. There was a history of repeated trauma to the left side of the head. Downward and outward displacement of the left eye was noted. The diagnosis of mucocele was confirmed by x-ray findings. An external frontal operation was performed and the patient's recovery was uneventful.

The third case was in a 51-year-old white man with complaint of pain over the right frontal and maxillary sinuses. Roentgenograms revealed a large rounded mass within the right antrum with slight haziness of the right frontal sinus. A diagnosis of mucocele of the right antrum and a mild right frontal sinusitis was made and confirmed by use of iodized oil. A Caldwell-Luc operation was performed on the right antrum and the mucocele was removed. The postoperative course was uneventful.

The fourth case is presented to bring out the difficulties of diagnosis. A 43-year-old Negro woman with all the classic findings of mucocele, clinical and roentgenological, was operated on through the external frontal approach, but instead of a mucocele a carcinoma was encountered. Radical exenteration of the left orbit was necessary.

Diagnosis is based on a history of painless progressive displacement of the eye in a downward and outward direction, diminished vision or diplopia, and trauma to the head in the past. Diagnosis is greatly facilitated by aspiration and roentgenography. The only adequate therapeusis seems to be radical exenteration through an external incision. In the case of mucocele of the frontal sinus an external frontal operation is recommended, while in the maxillary sinus a Caldwell-Luc operation is the one of choice.

From the pathology found in this series it seems that the mechanism of mucocele formation is initiated by (1) a submucosal injury, traumatic, hemorrhagic, or infectious, which causes (2) elevation of the mucosa with an accumulation of exudate beneath it; (3) herniation of the elevated mucosa occurs until it encounters the resistance of normal sinus mucosa of one of the sinus walls, where (4) pressure is exerted upon the mucosa and the underlying bone. The contents of the mucoceles are chiefly old blood elements, accumulation of red blood cells, and fibrous elements.

The external mucosal changes are primarily modifications of normal sinus mucosa. Normal cilia are absent and the columnar cells become cuboidal in type as a result of pressure. The inner wall of the mucocele is considerably thicker at the base where the initial injury occurred. It is composed of fibrous tissue and endothelial cells. In the beginning of the process, pressure stimulates bone apposition and leads later to bone resorption, giving the bone a thin, parchment-like appearance.

67. Tamari, M. T. and O'Neil, J. J.: Abstract of Mucoceles, Illinois M. J. **97**:96-97 (Feb.) 1950.

Kaplan, Schwartz, and Metson [68] list the causes of mucocele as osteoma, previous surgery, chronic sinusitis, obstructing polypi, and certain types of septum deviation. Diagnosis may at times be difficult. The condition must be differentiated from dermoid cyst, meningocele, osteoma, fibrosarcoma, sebaceous cyst, tumor of the lacrymal sac, fibrous dysplasia, and cholesteatoma. These are all considered briefly. Failure of surgery is due to closure of the nasofrontal passage by cicatricial contraction and encroachment of the orbital tissue. Eight cases are reported, in which tantalum foil or an acrylic obturator or both were employed. The primary results were good, but since the cases have been observed for less than one year, the authors are not prepared to draw final conclusions as to their efficacy.

Simonton [69] discusses treatment of nasal polyps under four headings, allergic, medical, surgical, and physical. The allergic treatment is self-explanatory. Medical treatment is indicated in cases of intrinsic or physical allergy and consists of the administration of vasodilating drugs such as histamine, nicotinic acid, and rutin. Antihistamines are useful in the acute exacerbations. Surgical therapy may be palliative through the simple removal of the accessible growths by means of the cold snare.

In certain instances if the anatomic configuration of the ethmoid labyrinth is favorable, a complete frontoethmoid exenteration via the external approach may effect a cure through complete removal of all mucosa. The dangers of the radical external operation are intracranial infection from softening of the roof of the ethmoid capsule, degeneration of the middle turbinate with loss of a valuable landmark, and damage to the cribriform plate. Also, degeneration of the olfactory epithelium opens perineural sheaths to possible infection.

Physical therapy consists of such procedures as linear cauterization, multiple puncture, zinc ionization, and irradiation. Analysis of 166 cases in which treatment with radium was used proves its value in certain cases. The dosage used was 150 mg.-hr. to each side of the nose after removal of polypi.

Maisonnave [70] differentiates secreting from nonsecreting cysts of the antrum according to the description of Lindsay [71] whom he cites freely. He states that the nonsecreting cysts which are due to a subepithelial diffusion of fluids from the capillaries are most likely to cause severe persisting headaches, whereas the true glandular cysts may be symptomless for a long period and are usually discovered accidentally in routine x-ray studies. Thirteen cases are cited and roentgenograms and histological sections are shown.

SURGERY

From a study of a large number of patients in the allergy clinic of the Massachusetts General Hospital, Weille [72] attempts to answer questions on the relationship of surgery to allergy of the nose and sinuses. One of the most important of these

68. Kaplan, S.; Schwartz, A., and Metson, B. F.: Mucocele of the Frontal and Ethmoid Sinuses, Arch. Otolaryng. **51**:172 (Feb.) 1950.

69. Simonton, K. M.: Treatment of Nasal Polyps, Collect. Papers, Mayo Clinic **41**:354, 1949.

70. Maisonnave, R.: Quistes mucosos de los senos maxillares, Gac. oto. laring. argent. **1**:19 (July) 1950.

71. Lindsay, J. R.: Non-Secreting Cysts of the Maxillary Sinus Mucosa, Laryngoscope **52**:84, 1942.

72. Weille, F. L.: The Effect of Nasal and Sinus Surgery upon the Manifestations of Allergy, New England J. Med. **242**:43 (Jan.) 1950.

questions is whether it is possible to predict which patients with asthma or vasomotor rhinitis will be benefited by surgery. The records of the clinic showed that 10% of the asthmatic patients were cured and 50% were benefited for periods up to two years. The results in the nasal cases were much better than in the asthmatic. The author claims good results in 80% of the former cases. The type of surgery indicated varies with the case. Intranasal ethmoidectomy is preferred to the external operation and is usually preceded by a submucous resection of the septum. The Caldwell-Luc operation is preferred for the antrum and, in cases of vasomotor rhinitis the turbinates are reduced by subepithelial diathermy coagulation. All these procedures, including the removal of polypi, are for the purpose of improving ventilation. It is also suggested that a specific allergy virus may be the cause of continued symptoms and may possibly be influenced by the eradication of affected tissues.

The author admits that at present it is impossible to predict which patients with asthma will be benefited. Cooperation with the allergist may assist in the selection.

The technique for closure of oroantral fistulas described by Herd [73] seems very simple. The mucoperiosteum of the maxillary alveolar arch is reflected from the tuberosity toward the cuspid eminence. After the sinus tract is carefully cleaned out and denuded of epithelium, the mucoperiosteum, which was previously freed from the maxilla, is incised high up with a Bard-Parker knife No. 11. The point of the blade is bent at an angle of 90° to provide a flap which is attached anteriorly and posteriorly but is freely movable throughout, thus enabling the surgeon to draw it down to cover the fistulous opening, to the margins of which it is then sutured.

Illustrations show the modified Bard-Parker blade and a diagram of the technique.

Richier and Delahaye [74] have used tribromoethanol ("rectanol") in 840 cases of surgery of the nose and sinuses without encountering any accident due to the anesthetic. The advantages claimed are that the patient goes to sleep and wakes up in his own room without nausea or vomiting and with total amnesia regarding the surgical episode. Surgical anesthesia is induced which lasts from one to one and a quarter hours, and the patient is usually asleep for four to five hours postoperatively. They recommended an enema to be given 12 hours before admission and an injection of "sedol" preoperatively. They find this more effective and less complicating than morphine or pantopon.® The dosage of tribromoethanol is fixed at 10 cg. per kilogram. A second dose may be given if the patient is unusually resistant or if the operation needs to be prolonged. Contraindications listed are extreme malnutrition and general debility, obesity, hepatic dysfunction, and advanced age.

They maintain that the anesthesia obtained is adequate for all surgical procedures about the head, provided that (1) the enema, the preoperative medication, and the rectal anesthestic are all administered at the proper time; (2) the initial dose of tribromoethanol is accurately calculated according to the patient's weight; (3) the supplementary dose, if required for prolonged cases, is determined with prudence; (4) the patient is carefully watched on being returned to bed and placed

73. Herd, R. M.: Technique for Closure of Antra-Oral Openings, Oral Surg. **3**:1385 (Nov.) 1950.

74. Richier, J., and Delahaye, G.: L'anesthésie au rectanol en chirurgie naso-sinusienne, Presse méd. **58**:844 (July 22) 1950.

on his side with a Mayo tube in place; (5) the anesthetic is administered by a qualified anesthesiologist.

Carco [75] calls attention to the fact that Citelli, in 1917, was the first to advocate trephining the frontal sinus in acute and subacute infections for the promotion of drainage. He also advocated a small trephine opening into the antrum in certain cases (through the canine fossa) which would be accessible for the subsequent introduction of a cannula for irrigation. Since then many others have described the same procedure without mentioning Citelli. With the advent of the antibiotics the procedure is perhaps less frequently indicated, yet its usefulness is still being demonstrated in cases where drainage is inadequate and threatening symptoms are impending. In these cases the antibiotics may be used locally as well as parenterally.

Koch [76] analyzes the results in the treatment of 585 patients with uncomplicated maxillary and frontal sinus infection: Of these, 203 patients had a radical operation because of irreparable changes in the mucosa; 318 patients were treated with local instillations of sulfonamides and penicillin; 198 were cured, 120 remained unchanged. Of the latter, 14 were later cured by an endonasal operation and local sulfonamide therapy.

Of 64 patients with chronic frontal sinus pathology, 21 were subjected to radical surgery, 5 were treated by Beck puncture; all were cured. Of 24 patients treated locally with sulfonamides, 11 were cured; the other 13 were eventually operated on.

There were 27 patients classified as having foci of infection affecting other tissues: 14 were operated on radically, 6 by antrostomy, and the rest were treated conservatively. In only 7 of the 27 patients was the remote disease uninfluenced by the sinus procedures.

It is apparent that only a small proportion of the patients were cured by conservative measures, although the author admits that the antibiotics and sulfonamides were helpful.

Oringer [77] presents a new technique for the closure of oroantral fistulas. An impression is taken of the alveolus and palate, which is worked up into a stone model. The proposed area to be denuded, representing a square with the fistula in the center, is scraped clean to the depth of the adjacent mucosa, and an impression of it is taken with dental wax. This serves as a pattern for the distal end of a palatal flap, which is outlined with wax and trimmed so that it fits accurately into the denuded alveolar space. These wax patterns are then employed at the operation so that the flap of mucosa is readily mobilized and rotated and then sutured into the margins of the denuded area. The area of the palate from which the flap is taken is covered with a dressing of zinc oxide, resin, and eugenol, with cotton fibers, or with an acrylic splint previously processed to cover the entire palate.

Converse and Smith [78] describe the repair of a cosmetic defect following resection of the maxilla for carcinoma. The deformity consisted of ptosis of the bulb due

75. Carco, P.: La méthode conservatrice de Citelli dans la chirurgie des sinusites frontales et maxillaires et son importance en epogue antibiotique, Oto-rhino-laryng. **37**:101 (June) 1949.

76. Koch, J.: Über die Auswahl der Behandlung bei chronischen Kiefer- und Stirnhohlenerkrankungen, Ztschr. Laryng., Rhin. Otol. **29**:313 (July) 1950.

77. Oringer, M. J.: Plastic Closure of Alveolar Antral Traumatic Perforations and Chronic Fistulae, Presenting an Improved Technique, Oral Surg. **3**:410 (April) 1950.

78. Converse, J. M., and Smith, B.: Case of Reconstruction of the Maxilla Following Resection for Carcinoma of the Antrum, Plast. & Reconstruct. Surg. **5**:426 (May) 1950.

to loss of orbital floor, deepening of the superior palpebral fold, and flatness of the cheek. The technique employed consisted of exposure by way of an incision paralleling the lower lid and extending down the side of the nose. The orbital contents were liberated from binding scars and raised. A single bone graft was placed in position to form the orbital margin and the remainder of the denuded area was filled with small bone chips. Finally an overlay of smooth bone was placed over the bone chips to form the contour of the cheek, which was then sutured back. All the grafted bone was obtained from the iliac crest. Pressure was maintained for seven days, and a dental prosthesis previously constructed with an obturator holding the soft tissues from within was left in situ throughout.

Lyman [79] reviews the literature on the obliterating operation on the frontal sinus very extensively and presents several case reports illustrating the various categories which he believes indicate this procedure. These are traumatic cases, acute fulminating infections with spreading involvement of bone and impending complications, and chronic infections showing low grade osteomyelitis as evidenced by draining fistulas, localized areas of necrosis, and degeneration of the mucosa. All three of these groups represent cases of infection with irreversible changes. In such cases both the anterior wall and the floor of the sinus should be removed along with the contents of the sinus. The posterior wall need not be removed unless there is evidence of definite pathology or intracranial extension. The deformity can be minimized by proper beveling of the bone margins and by the use of a gently curving horizontal incision through the bone.

When the bone is not involved, the author recommends the Lynch operation, leaving the nasofrontal duct intact. In the few cases in which the duct is destroyed by disease or previous operation and in which obliteration is not indicated, Lyman suggests maintaining the patency of the duct by the use of the Ingals gold tube.

NONSURGICAL THERAPY

Williams [80] calls attention to the change from the anatomic and pathological viewpoint to an appreciation of physiological processes which has influenced our ideas about chronic sinusitis. Formerly headache was considered a prominent feature of chronic sinusitis. Today we know that headache is rarely a prominent feature unless the infection is complicated by an allergic factor. The presence of headache should always lead to a search for factors which cause cranial blood vessel tension and affections of the postcervical muscles and tendon sheaths.

The presence of eosinophiles in diseased sinuses, while indicating an allergic element, does not necessarily mean that specific desensitization will cure the patient, because frequently the condition is not a true antigen-antibody phenomenon but rather a manifestation of physical allergy, or "physical pathergy" as termed by Urbach. Besides, the presence of pathogenic bacteria causing definite changes in the mucosa means that the nonallergic portion of the process must be dealt with properly without respect to the allergy.

The therapy in such cases should embrace nonspecific antiallergic medicaments that relieve the capillary spasm due to parasympathetic overactivity, such as nico-

79. Lyman, E. H.: The Place of the Obliterative Operation in Frontal Sinus Surgery, Laryngoscope **60**:407 (May) 1950.

80. Williams, H. L.: Changing Concepts in Chronic Sinusitis, Collect. Papers, Mayo Clin. **41**:365, 1949.

tinic acid and other vasodilators, and surgical measures for the removal of diseased sinus tissues. Simultaneous involvement of the antrum and the anterior ethmoid sinuses will in most cases yield to simple intranasal antrostomy. Chronic fronto-ethmoid disease may necessitate an external operation.

In addition to general measures, humidifiers, etc., Simonton [81] recommends antibiotics in acute sinusitis. Penicillin has been found to be effective against 80% of the bacteria usually dominant in these cases. It is most effective when given intramuscularly, having little effect when used locally or by inhalation. Surgery is to be avoided except occasionally when trephine of the floor of the frontal sinus may be indicated.

In cases of subacute infection of the antrum, lavage is effective, preferably via the natural orifice whenever it is accessible.

Chronic antrum infection may in some instances yield to repeated irrigation. It is important in all chronic sinus disease to remove or correct such anatomic deformities within the nose as may interfere with proper ventilation and drainage. Drainage of the antrum may be facilitated by an intranasal antrostomy, and chronic ethmoid infection may require intranasal or external exenteration, depending on the extent and severity of the disease. These operations, however, are becoming less urgent owing to the influence of the antibiotics in acute cases.

Middleton and Rider [82] administered pyrilamine (neo-antergan®) maleate and phenindamine (thephorin®) to a series of 63 patients with the common cold and evaluated the results in comparison with a control group of 29 treated with placebos. From their observations, neither the duration of symptoms nor the history of allergy seemed to play any part in the results. About 75% of the patients treated with the antihistaminics showed definite improvement as against about 45% of the patients treated with placebos. In no case could there be positive assurance of a cold having been "aborted." The fact that such a large percentage of patients treated with placebos showed definite improvement should give one pause when attempting to evaluate a drug in similar cases.

Upon an analysis of several reports on the use of antihistaminics in the treatment of the common cold, as well as an investigation by the author and his associates, Fabricant [83] concludes that these drugs do not prevent, abort, shorten, or stop the common cold, and are no more effective than placebos. The author's investigation covered a group of 213 students, some of whom were given various antihistaminics while others received placebos, neither group knowing which was which. The subjects were all carefully examined at the onset of the cold, during the progress, and at its termination, and the results were carefully tabulated. There was no difference in response between those receiving the drug and those given the placebo. Furthermore, the incidence of side effects was high enough to suggest caution in the use of antihistaminics and certainly to curtail their indiscriminate use.

Thacker [84] stresses the need for an ideal nasal and sinal medicament. Many nasal solutions have been used without sufficient regard for the accuracy with which

81. Simonton, K. M.: The Treatment of Sinusitis, Collect. Papers, Mayo Clin. **41**:361, 1949.

82. Middleton, J. W., and Rider, J. A.: Antihistaminics in the Treatment of the Common Cold: A Preliminary Report, Dis. Chest **16**:879 (Dec.) 1949.

83. Fabricant, N. D.: Critical Evaluation of Antihistaminic Drugs in the Common Cold, Arch. Otolaryng. **52**:888 (Dec.) 1950.

84. Thacker, E. A.: Nasal Solutions with Combined Therapeutic Effects, Eye, Ear, Nose & Throat Month. **11**:609 (Nov.) 1950.

they are dispensed. With so many proprietary preparations now available one is likely to be confused as to their efficacy. The author reviews the investigative work of the past few years, and mentions indications and contraindications for some of the proposed therapy. He comments that an ideal nasal preparation should meet certain criteria, on the basis of which the following formula has been developed. This may be used alone or in combination with certain other therapeutic drugs:

	Gm. or Cc.
Antazoline hydrochloride[a]	0.125
Phenylephrine hydrochloride[b]	0.250
Sodium bisulfate	0.0125
Sodium phosphate	0.333
Monobasic potassium phosphate	0.167
Potassium chloride	0.344
Sodium chloride	0.218
Methylcellulose (4,000 centipoises)	0.100
Benzalkonium zephiran® solution (1:5,000 qsad) 100.00 cc.	.....

This formula, which has been worked out and tried clinically, approaches the ideal medicament for nasal and sinal diseases from the pharmacological, physiological, and therapeutic viewpoints. It can be compounded readily by the pharmacist and is submitted to the medical profession as a solution to a vexing problem which has heretofore been neglected.

Eastlake [85] describes a simple apparatus for home use whereby penicillin aerosol may be introduced into the sinuses by negative pressure when the bulb is released, after one has sprayed the aerosol powder into the nose. A soluble penicillin tablet dissolved in isotonic sodium chloride solution or phenylephrine (neo-synephrine®) hydrochloride is sprayed into the nose three times as the patient inhales. At the end of the third squeeze the opposite nostril is closed with the finger and the patient swallows as the bulb is allowed to expand. Negative pressure thus induced causes the mist in the nose to be sucked into the sinuses. In the course of a day 100,000 to 200,000 units dissolved in 1 cc. of a 1% phenylephrine hydrochloride solution can be used up.

Ruskin [86] maintains that solutions of penicillin procaine, 3,000 to 5,000 units per cubic centimeter, when instilled into the sinuses, have a beneficial effect in chronic infections and will reduce the incidence of polyposis. This is based on the prolonged local action of the penicillin combined with the antihistamine effect of the procaine in reducing the congestion. He advises adding 1 cc. of procaine-penicillin solution containing 300,000 units, to 60 cc. (2 oz.) of sterile isotonic sodium chloride solution and injecting 10 cc. into each antrum and 5 cc. into each sphenoid sinus.

Klenner [87] maintains that failure of antibiotics and sulfonamides in local therapy of sinusitis is due to the brief contact of the medicament with the sinus mucosa. To overcome this deficiency, the author has combined penicillin (1,500 units) and sulfonamide glucoside in 5 gm. of a bland basic ointment. After irrigation through a Lichtwitz needle, the fluid is expelled by air pressure and then about 1 to 2 cc.

85. Eastlake, C., Jr.: Aerosol Therapy in Sinusitis, Bronchiectasis and Lung Abscess, Bull. New York Acad. Med. **26**:423 (June) 1950.

86. Ruskin, S. L.: Procaine Penicillin Solutions in the Treatment of Nasal Polyposis, Laryngoscope **60**:111 (Jan.) 1950.

87. Klenner, P. M.: Die lokale Behandlung von Kieferhöhlenempyemen mit Penicillin-Sulfonamid Kombination in Salbenform, Med. Monatsschr. **4**:370 (May) 1950.

of the ointment forced into the antrum. The procedure is not repeated until a week later, when irrigation will demonstrate some of the material still present. Several cases are cited.

Shaw and Wightman [88] conducted a survey of 443 students at the Cornell University Student Medical Clinic, who were reporting for the treatment of colds. Only those were considered in whom the symptoms were present for less than 48 hours. Careful histories were taken with reference to past incidence of colds, examinations recorded the local findings, and the patients were then divided into two groups, one half receiving an antihistaminic (2-phenyl-benzylamino-methyl-imidazoline hydrochloride) and the other half a placebo of the same appearance. Medication was given for three days and the patients were then followed for four more days.

The results showed 50% of those receiving the placebo reported improvement as compared with 53% of the group taking the antihistaminic. It was noted that in the latter group the best results were obtained in patients having a definite history of allergy.

Hüsten [89] found that weak concentrations of penicillin (1 to 3,000 units per cubic centimeter) were ineffective in the local treatment of sinusitis. Good results were obtained after the concentration was raised to 10,000 to 20,000 units. However, in chronic cases, especially those associated with polypoid degeneration, the antibiotic failed to yield as good results as had been obtained with an iodoform-glycerine combination. Nevertheless, in acute and subacute infections when the bacterial flora were penicillin-sensitive the local use of solutions mentioned yielded good results.

Blatt and Nantz [90] claim definitely favorable results in the treatment of chronic sinusitis by means of specific desensitization. Patients for whom this therapy is suitable are characterized by frequent attacks during the winter, presence of thick mucoid secretion, inflammatory appearance of nasal mucosa, absence of pollen sensitivity, and resistance to the usual therapy, including antihistaminics. The difficulties in carrying out the treatment are due to the length of time it takes and the effort to maintain sterile filtrates. Patients are tested with about 100 bacterial filtrates. The procedure has been described in detail by the authors in a previous publication.[91]

Injections of the filtrate to which the patient's blood is sensitive are given at intervals of three to four days, the dose beginning with a 1 : 1,000,000 solution and increasing in strength as tolerated. In successful cases patients have remained free from symptoms up to two years.

The authors recommend retesting the patients every six months to see whether they have become hypersensitive again. Several typical cases are presented.

Morrison [92] has been experimenting with radiocobalt as a substitute for radium in the treatment of malignant conditions of the nose and sinuses and is very much

88. Shaw, C. R., and Wightman, H. B.: A Study on the Treatment of the Common Cold with an Antihistaminic Drug, New York J. Med. **50**:1109 (May) 1950.

89. Hüsten, W.: Die örtliche Anwendung des Penicillins bei Erkrankungen der Nasennebenhöhlen des Mundes und Halses, Therap. Gegenw. 1949, p. 27.

90. Blatt, H., and Nantz, F. A.: Sinusitis Due to Bacterial Allergy: Identified by Tissue Culture and Treated by Specific Desensitization, Ohio M. J. **46**:319 (April) 1950.

91. Nantz, F. A., and Blatt, H.: Application of Tissue Culture Technique in Clinical Evaluation of Bacterial Hypersensitivity, Ann. Allergy **5**:554, 1947.

92. Morrison, L. F.: Radiocobalt in Otolaryngology, A. M. A. Arch. Otolaryng. **52**:153 (Feb.) 1951.

encouraged by the early results. The reaction is no different from that which follows radium irradiation and the advantage is in its cheapness as compared with the cost of radium. A further advantage is the higher degree of activity. Almost pure gamma radiation is obtained, which may be activated up to ten times that of radium. Furthermore, the beta radiation is only 4% of the total and is readily screened with a layer of silver plate measuring 0.08 to 0.16 mm. in thickness. It is supplied in beads measuring 3.0 to 6.0 mm. which afford a point source of emanation. A diagram shows a bead threaded into a Foley catheter for local application.

The only disadvantage of the radiocobalt is that it deteriorates at a much faster rate than radium, having a half life of 5.3 years.

Roux [93] reports gratifying results in 50 consecutive cases of subacute and chronic sinusitis from the use of displacement therapy, employing a 1% solution of ephedrine in isotonic sodium chloride solution. Four to eight treatments were given at three- to seven-day intervals, treatment being stopped when the washings were clear and the symptoms had subsided. Most of the patients were relieved of their postnasal discharge, obstruction, and headaches. In some cases polypi were removed, the septum straightened, and window resections performed. The author does not maintain that displacement therapy is a cure-all, but believes that, if faithfully carried out, it will greatly accelerate recovery even when other measures have to be carried out. He states further that his best results were obtained in the subacute catarrhal type.

Unger [94] maintains that use of nasal irrigations with a saline solution (4 gm. to 500 cc. of water) at a temperature of 115 to 120 F., repeated frequently, is the most rational way of treating an acute rhinosinusitis. This is based on the assumption that it facilitates the expulsion of the excessive secretions which are thrown out by the tissues in combating the infection. In other words, the rapid removal of these secretions plus the infective material embedded in them is what facilitates restoration to normal.

Unger [95] describes the technique of irrigating the maxillary sinuses via the natural ostium with specially designed cannulas for the right and left sides. He states that this can be accomplished in most cases without preliminary cocainization. He advises frequent irrigations in chronic cases because the antrums serve as repositories for secretions from the frontal and ethmoid cells via the infundibulum.

Quigley [96] employed irradiation in 325 cases of tonsil, adenoid, and sinus disease with satisfactory results and argues that recurrences are due to failure to remove etiological factors originally overlooked. These include mostly improper dietary habits. He recommends a high protein, high mineral, high vitamin diet, including milk, eggs, cheese, raw fruits and vegetables, fresh meat, sea foods, and whole wheat bread. Sugar, white flour, canned goods, soda fountain drinks, and candy are barred. There is very little reference in the article to the types of sinus disease treated.

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93. Roux, D. J.: Observations on the Proetz Displacement Therapy in Sinusitis, South African M. J. **24**:356 (May 13) 1950.

94. Unger, M.: Rational Therapy for Common Colds and Nasosinusitis, New York J. Med. **50**:295 (Feb. 1) 1950.

95. Unger, M.: Irrigation of the Maxillary Sinus Through the Natural Openings, Arch. Otolaryng. **52**:786 (Nov.) 1950.

96. Quigley, D. T.: Radiation Treatment of Tonsils, Adenoids and Sinuses, Nebraska M. J. **35**:253 (Aug.) 1950.

Osborne and Ballenger [97] found microwaves of definite benefit in the treatment of chronic maxillary sinusitis, discovering an average elevation of intra-antral temperatures of about 1.35 F., which they believe is sufficient to increase the metabolism within the tissues, thus hastening resolution of pathological processes. The director was placed two inches from the skin and the generator operated at 80 to 85% of its total output, which was the average heat tolerance. The treatments usually lasted 20 minutes, and the temperatures were recorded before and after by means of a thermocouple inserted into the sinus through the natural ostium.

CLINICAL—GENERAL

Gill-Carey's article,[98] intended for the general practitioner, presents a lucid picture of sinusitis in general. He states that 30% of sinus disease is infective or suppurative and primarily nasal in origin. The other 70% is a more or less obscure pathological state because the sinusitis is a manifestation of a constitutional condition which may be endocrine, allergic, or dietary in origin. Proper analysis of these factors with adequate therapy will generally lead to amelioration of the nasal symptoms. The author points out the essential items in the investigation of the patient's habits and gives a résumé of the currently accepted conservative therapeutic procedures.

Netto [99] attempts to cover all the causes of nasal obstruction, local and constitutional, in a rather short article. He also discusses various therapeutic measures such as desensitization and x-ray and radium treatments and concludes with a recommendation of aerosol therapy in chronic maxillary and ethmoid infection.

Osmun [100] defines sinusitis as a "symptom-complex of considerable variability" and lists its basic features as "wet obstructed nose, postnasal drip, dull frontal or occipital headache, cervical myalgia, and mental depression." He maintains that 50% of the symptoms are due to allergy. He decries the frequent use of vasoconstrictors, except ephedrine in isotonic sodium chloride solution, and advises looking for constitutional disturbances as the factors to be corrected. Hypothyroidism, the climacteric, excessive carbohydrate consumption, tonsils, adenoids, dental caries, etc., are mentioned in this connection.

Myerson [101] stresses the necessity for a thorough and careful examination of the patient and analysis of the history in cases in which headache or pain is attributed to a sinus infection. Among the cases cited are one which was due to a small encapsulated abscess in the ethmoid sinus, another in which the headaches were due to diabetes, a third which was on an emotional basis, and a fourth case in which the patient was found to be a narcotic addict.

Tremble [102] states that the commonest causes of postnasal discharge are low-grade chronic infection of the antrum, ethmoid and sphenoid sinuses, hypertrophy

97. Osborne, S. L., and Ballenger, J. J.: Heating of the Human Maxillary Sinus by Micro-Waves, Brit. J. Phys. Med. **13**:177 (Aug.) 1950.

98. Gill-Carey, C.: Acute and Chronic Sinusitis, Brit. M. J. **2**:427 (Feb. 18) 1950.

99. Netto, O. C.: Obstrucão nasal e sinusites, Rev. brasil. oto-rino-laring. **17**:89 (May-Aug.) 1949.

100. Osmun, P. M.: Sinusitis, Northwest Med. **48**:857 (Dec.) 1949.

101. Myerson, M. C.: Special Considerations in Nasal Sinusitis, Ann. West. Med. & Surg. **4**:297 (June) 1950.

102. Tremble, G. E.: Mechanics of the Nose, with Special Reference to Nasopharyngeal Discharge, Arch. Otolaryng. **51**:205 (Feb.) 1950.

of the inferior turbinates, especially their posterior tips, and hyperplasia of lymphoid tissue in the nasopharynx and pharynx. Numerous other causes are cited from the literature. Therapy hinges on accurate appraisal of the patient as a whole. Allergic conditions must be diagnosed and treated. Anemia, emotional disturbances, metabolic irregularities, etc., frequently enter into the picture and have to be treated according to the indications. Small doses of thyroid extract have been helpful in many cases. The antrum and sphenoid sinus may require irrigation. The inferior turbinates are reduced by the application of fuming nitric acid, and the technique is fully explained. In some cases the shrinkage is accomplished by diathermy applied through twin needles buried submucously.

MAXILLARY, DENTAL, DISEASE

Wakefield [103] points out the importance of properly executed roentgenograms expertly analyzed in cases in which a pathological condition of the antrum of dental origin is suspected. A translucent area in the premolar area might be thought to be a cystic cavity when in fact it is caused by the outline of a segmented portion of the sinus. However, if its posterior dense bony wall meets the nasal floor, forming a Y, there can be no doubt that the area is a sinus cavity and not a cyst. Several excellent x-ray pictures bring out these points very clearly.

"Apical pathology involving the floor of the antrum is not easy to detect, since once eroded into the antral cavity, the granuloma may not give a conclusive definition in the radiograph." Several different projections are advised to bring out the various roots of a molar, and in some cases a magnifying glass is helpful in locating a rupture of the periodontal membrane. Transillumination is also recommended in questionable cases.

Exploratory puncture of a suspected cyst is advised in cases in which roentgenograms and transillumination fail to make the diagnosis certain. Aspiration may disclose a cyst, whereas if the needle is in the sinus the injection of air may be detected as it passes through the sinus ostium into the nasal cavity.

The author mentions the various diagnostic points pertaining to the status of the tooth roots, as seen in x-ray pictures, which should be understood by dentists. He also discusses techniques for the extraction of posterior teeth and the pitfalls to be avoided.

Richter [104] states that neuralgias affecting branches of the fifth nerve may be caused by periapical infections of the teeth, particularly the second bicuspid and the first molar. Also, such a focus may be responsible for disorders in remote areas, such as arthritic pains, digestive disturbances, febrile attacks, etc. He maintains that crowned teeth are most likely to be the seat of such infections, which not only cause apical granulomas but also cystic formations which invade the antrum and may even entirely fill it. Several cases are cited to illustrate the point, and emphasis is laid on two observations, namely, that frequently nasal symptoms are absent and that the diagnosis can only be arrived at by careful roentgenography. One must not be deceived by a negative irrigation of the sinus because extensive polyposis may

103. Wakefield, B. G.: Diagnosis and Surgery in the Maxillary Area, Oral Surg. **3**:713 (June) 1950.

104. Richter, H.: Über dental bedingte chronische Entzündungen und Zysten der Kieferhöhle, Deutsch. med. Wchnschr. **75**:893 (June 30) 1950.

be present without suppuration. Furthermore, exploratory puncture may enter the cyst rather than the sinus cavity.

Loza [105] describes papillar rhinosinusitis as an inflammatory condition affecting the ethmoids, or frontal or maxillary sinuses, in which the cylindrical epithelium undergoes metaplasia with conversion into squamous epithelium, forming papillary excresences which extend deeply into the stroma. However, though simulating malignant degeneration, they seldom infiltrate or break through the limiting membrane. The cause is assumed to be a virus. There seems to be an element of contagion in its makeup, and in some respects the condition resembles recurring papilloma of the larynx. The process may extend from the sinuses into the nasal cavity and involve the turbinates.

Examination reveals a papillary hyperplasia about the anterior ends of the turbinals, which may progress to tumor formation. In advanced cases the underlying bone may be destroyed by the advancing growth. Conservative surgery is recommended, followed by irradiation because of the tendency to recurrence.

Several histopathological slides are shown demonstrating the metaplasia of the surface epithelium and the deeper extensions.

Ballenger and Osborne [106] were able to record an average increase in temperature of 135 F. in eight patients with chronic maxillary sinusitis after their exposure to microwaves. A microtherm operating at a frequency of 2,400 to 2,500 megacycles on a wave length of about 12.2 cm. with a maximum output of 125 watts supplied the microwaves which were directed at the antrum through a director placed a distance of 2 in. from the face. Heat tolerance was reached with the generator operating at 80 to 85% of capacity. Average exposure time was 20 minutes. The intra-antral temperatures were taken before and after the treatment by means of a thermocouple introduced into the natural ostium. The authors suggest that although the increase of temperature may not appear to be of great importance, it is possible that the increased blood flow induced may prove of definite therapeutic value.

In a comprehensive monograph Martensson [107] first reviews the anatomy of the maxillary sinus in relation to teeth, and then summarizes previous work done by many other investigators, to determine the effect of the Caldwell-Luc and Denker operations on the teeth. He finds the literature inconclusive and contradictory due to variations in techniques, methods of investigation, and other factors, such as lack of radiograms of the teeth and histological examination of the pulp. Most of the writers conclude that sensitivity is impaired immediately after the operation but returns gradually to normal.

The author's investigation covers 247 patients according to the type of operation employed; 122 were followed up for 2 to 17 years.

The apparatus used for testing sensitivity was Björn's stimulator, which is described in detail. It is so constructed that the exact amount of electrical current necessary to elicit sensitivity can be accurately tabulated. One applies the electrode

105. Loza, M. G.; Maisonnare, P., and Benito y Navarro, J. V.: Rinosinusitis Papilar, G. O. L. A. **1**:9 (July) 1950.

106. Ballenger, J. J., and Osborne, S. L.: Heating of the Human Maxillary Sinus by Microwaves, Arch. Otolaryng. **51**:678 (May) 1950.

107. Martensson, G.: Dental Injuries Following Radical Surgery on the Maxillary Sinus, Acta Otolaryng., Supp. 84, 1950.

to the incisor edges or the various cusps of premolars and molars, being careful to avoid contact with any fillings. Threshold values are computed on the microampere values according to a logarithmic scale. Roentgenograms of the teeth and of the extent of gingival sensitivity are also employed.

Histological examination was made of 24 anesthetic teeth subsequently extracted, and the findings were recorded. The details of these findings make interesting reading. In the main, they show degenerative changes in the nerves of the root pulp. A summary of Martensson's findings shows that dental sensitivity is impaired on both sides operated and not operated on; the changes are more manifest in the premolars of the side operated on. In most cases normal sensitivity returns, but in some cases the condition is permanent. The factor responsible is the resection of the facial wall and not the damage to the sinus mucosa. The records indicated 20 instances of permanent impairment of sensitivity out of 112 patients operated on who were followed up.

Investigation of the 20 cases cited showed the operative trauma very close to the roots of the teeth; the deduction, therefore, is that the facial opening be made as far away from the roots of the teeth as possible. Yet, considering the value of the operation in selected cases, the possibility of permanent damage to the teeth should not enter the picture.

The author points out several important dental factors to be considered. First, the patient should have proper preoperative dental care. Foci of infection should be eliminated lest they develop without symptoms during the postoperative anesthesia period. In the postoperative period an insensitive tooth should not be considered "dead" and be sacrificed unless there is radiologic evidence of pulp decay.

A diagram showing the distribution of the sensory nerves is shown depicting an area in which there are few fibers. This forms the basis for a modified technique whereby the possibility of damage to fibers entering the apices of the teeth is minimized.

Fabbi [108] presents two cases of hyperplastic papillary sinusitis. One of the patients suffered from a neuroarthritic diathesis and the other gave a history of tuberculosis. Histologically the mucosa presented a marked thickening of the epithelium with replacement of the columnar cells by layers of stratified squamous cells heaped into papillary masses. The author suggests the possibility of a virus as the cause of the degenerative change. The symptoms are not characteristic, being those usually observed in chronic suppurative sinusitis, and the treatment is exenteration.

Del Magro [109] reports a case of an apparent cyst of the maxillary sinus in a man of 38, whose complaint was a dull sensation or feeling of pressure in the right upper jaw for about two years. The excised tissue showed hemorrhagic areas with accumulation of masses of cholesterin crystals. He cites Manasse and other writers who attribute the condition to a long-standing venous stasis in a low-grade inflammatory process leading to a hydrops with extravasation of blood and precipitation of cholesterin crystals.

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108. Fabbi, F.: Sulla sinusite iperplastica papillare, Riv. oto-neuro-oftal. **25**:127 (March-April) 1950.

109. Del Magro, A.: Ulteriore contributo alla conoscenza della sinusite cronica emmoragico-cholesterinica, Arch. "de Vecchi" anat. pat. **13**:1039 (Nov.) 1949.

Davis [110] discusses the anatomic and etiological factors in acute maxillary sinusitis, which he divides into four types: (1) a complication of coryza, (2) direct infection from swimming or diving, (3) infection secondary to dental pathology, and (4) allergy. He advises early irrigation for the removal of secretions and describes antrum puncture through the inferior meatus. He suggests the use of 2 cc. of 1 : 4,000 thimerosal (merthiolate®) following the irrigation, not for its therapeutic effect but because the color may serve as an index as to whether other sinuses are involved. If the fluid subsequently expelled by the patient is pink, the conclusion is that the antrum alone is affected; if pink and yellow, it means that the antrum is not draining and the secretion comes from other sinuses.

FRONTAL, ETHMOID AND SPHENOID SINUS DISEASE

Johnson [111] studied 143 case records of frontal sinusitis from the files of the Los Angeles General Hospital and presents considerable data on the various clinical problems involved. Since the material covers a 10-year period, from 1938 to 1948, it is possible to draw conclusions based on comparison of the preantibiotic group with that which had the benefit of this therapy.

The author finds that the incidence of frontal sinusitis has not diminished but complications and deaths show a definite decrease. The hospital stay has also been cut nearly in half. Emphasis is placed on adequate early therapy, and the value of a trephine opening in certain acute cases is also stressed. The latter procedure is described in detail.

Goodale [112] states that the treatment of acute frontal sinusitis depends on a proper evaluation of the individual case. Anatomic factors and the degree and type of infection influence the course of the disease. Palliative therapy is successful in most cases. However, when the symptoms are severe and fail to abate promptly, trephining through the floor for drainage is recommended. It is important that the case be followed up to complete resolution, lest foci be left unhealed, predisposing to recurrences or chronicity. Antibiotics and sulfonamides play an important role both in early therapy and in surgical treatment, but must not be relied on entirely to the exclusion of surgery when the latter is indicated. Recurring attacks may call for radical surgery, in which case the type of operation will depend on the degree of destruction and the status of the duct. If the latter is capable of functioning, it should not be traumatized. If it is beyond repair, it may be necessary to perform an obliterating operation. This has to be very thorough, otherwise residual mucosa may become the seat of reinfection.

Carotid cavernous aneurysm may be due to trauma or may arise spontaneously. Rupture of the artery causes an excess of blood under pressure to accumulate in the venous space. The back flow into the ophthalmic vein causes symptoms suggesting thrombosis of the cavernous sinus with proptosis, chemosis, and paresis of ocular muscles. Presence of pulsation and bruit and absence of temperature elevation should lead to correct diagnosis. Corroboration may be obtained via injection of

110. Davis, H. L.: Acute Infectious Maxillary Sinusitis, Texas J. Med. **46**:292 (May) 1950.

111. Johnson, F.: Ten Year Study of Frontal Sinusitis at the Los Angeles General Hospital, Arch. Otolaryng. **52**:129 (Aug.) 1950.

112. Goodale, R. L.: Treatment of Acute Frontal Sinusitis, Ann. Otol. Rhin. & Laryng. **59**:446 (June) 1950.

contrast media into the carotids. This was proved in the case reported by Walander.[113] This case at first was taken to be that of an acute ethmoiditis because of unilateral headache with edema of the lids and impaired vision. The patient's condition healed spontaneously, probably through a thrombus occluding the fistula in the artery. The author cites Sattler as having collected 322 cases from the literature, in 169 of which (5-6%) spontaneous healing took place.

Ricci [114] suggests that agenesis or failure of the frontal sinus to develop may be the cause of frontal headaches and neuralgic pains. He attributes the symptoms to irritation of the sympathetic and trigeminal nerves due to the mass of bone occupying the space which should house the sinus. He reports 13 cases in which removal of the heavy bone at the superointernal angle of the orbit and opening into the ethmoid cells has relieved the symptoms.

Giaffrida [115] describes a syndrome of frontal headache more or less continuous, with acute paroxysms and short remissions, which is found in association with aplasia of the frontal sinus. The condition has previously been noted by Tilley, Chamberlain, Skillern, and Gignoux, whose findings are cited. Previous trauma and a chronic obliterative ossifying process are assumed to be the causes. In the patients mentioned by the author relief was obtained by surgery; either removal of the excess bone or turbinotomy with exenteration of the ethmoids was done. In several cases an allergic factor was discovered which, after appropriate treatment, led to recovery.

Rongetti and Daniels [116] report a case of empyema of the sphenoid sinus with osteomyelitis and erosion into the pituitary fossa. The patient, a man of 66, gave a history of headache and projectile vomiting. Other symptoms were visual impairment, continuous thirst, and increased urinary output. Roentgenograms showed erosion of the sella turcica and a diagnosis of neoplasm was made, which led to a craniotomy. Since no tumor was found, the tense bulging diaphragm of the sella was aspirated, revealing pus. Subsequent nasal examination revealed ethmoid and sphenoid disease. The ethmoid sinuses were opened and the sphenoid sinus entered. It was filled with pus. Palpation showed destruction of the posterior wall. Roentgenograms with a mushroom catheter in the cavity show its extremity reaching far into the pituitary fossa. A continuous penicillin drop was carried out through the catheter. In addition penicillin was administered intramuscularly every three hours, and the patient made a perfect recovery.

HEADACHE

Mori and Borriglione [117] employed an anesthetic solution by the Lima displacement method in 43 cases of headache associated with sinus disease. Of 23 cases in

113. Walander, A.: Carotid-Cavernous Aneurysm Simulating Acute Ethmoiditis, Acta Otolaryng. **38**:246 (June) 1950.

114. Ricci, F. C.: Quadri morbosi in soggetti con aganesia o scarso svilluppo seno frontale, Oto-rino-laring. ital. **18**:325, 1950.

115. Giaffrida, E.: Neuralgic Syndromes Associated with Aplasia of the Frontal Sinus, Ann. Otol. Rhin. & Laryng. **59**:152 (March) 1950.

116. Rongetti, J. R., and Daniels, J. T.: Treatment of Empyema of the Sella Turcica of Sphenoid Origin, Arch. Otolaryng. **52**:166 (Aug.) 1950.

117. Mori, M. C., and Borriglione, G.: Sugli efetti dell'anestesia della mucosa sinusale nella cefalea da perisinusite, Oto-rino-laring. ital. **18**:417, 1950.

which there were no internal disturbances to confuse the picture the headache disappeared in 19. The authors attribute the effectiveness of the procedure to the action of the anesthetic solution on the terminals of the neurovegetative apparatus. The results were particularly striking in those cases in which an allergic factor was dominant.

Stevens [118] studied 100 patients with chronic persisting headache associated with postcervical tenderness and found that 35 had attributed the trouble to eyestrain, whereas 65 sought relief at the hands of the rhinologist. In the first group it was found that, while some amelioration was obtained from correction of refractive errors and muscle imbalance, complete relief did not follow until the neck muscles were treated locally.

About 80% of the second group showed some evidence of a mild vasomotor rhinitis. In these cases the headache could not be attributed to the nasal condition, except in those instances in which the engorgement of the turbinates was well marked.

The influence of cold was well defined, since 75% of the entire group suffered mostly during the winter months.

The treatment followed was that suggested by Seydell: protection against cold and drafts, exercise of the neck muscles, local heat, and the application of a small amount of histamine ointment (imadyl unction*) with continuance of the heat. This was followed by gentle rotary massage. The application of infrared heat followed by light massage and the use of alternately hot and cold showers were also found to be of value. The injection of procaine hydrochloride 1% was useful in some cases for temporary relief.

McAuliffe, Wolff, and Mueller [119] made a study of 80 patients with the object of evaluating pain and headache resulting from irritation of intranasal tissues. Taking the sensitivity of the tip of the tongue to the Faradic current as a value of 1, they found that the sensitivity of the nasal septum was 1 to 2; the turbinates 4 to 6; the nasofrontal duct 5 to 7; the ostium 6 to 9, and the lining of the sinuses 1 to 2. This seems to indicate that painful reactions are the result of irritation of the intranasal structures, particularly the turbinates and areas about the ostium rather than the sinus lining itself. This is borne out by clinical observation. Extensive disease of the sinus mucosa may be present without pain, whereas an accompanying swelling or inflammation about the ostium or the turbinates may cause a definite pain response. These pains are not referred to the site of irritation but rather to the ramifications of the first and second divisions of the fifth nerve.

TRAUMA

Hsiao [120] reports a case of bleeding from the nose in a man of 29, who sustained a gunshot wound of the face about three months previously, the missile having passed completely through. The hemorrhages were recurring frequently and the loss of blood was considerable. Roentgenograms showed fracture of the upper end of one zygoma and cloudiness of both antrums. The antrum on the affected side was opened

118. Stevens, R. W.: Chronic Indurative (Cervical Myalgia) Headache, Arch. Otolaryng. **51**:196 (Feb.) 1950.

119. McAuliffe, G. W.; Wolff, H. G., and Mueller, G. C.: Experimental Studies on Headache: Pain Originating in Nasal and Paranasal Structures, New York J. M. **50**:1113 (May) 1950.

120. Hsiao, S. C.: Severe Hemorrhage from Right Maxillary Sinus After Gunshot Wound, Chinese M. J. **67**:447 (Aug.) 1949

sublabially, when a severe hemorrhage occurred, necessitating a full pack before the area could be explored for the bleeding vessel. When the pack was removed the bleeding recurred. The external carotid artery was then ligated, and the hemorrhage stopped. Because of extensive swelling the sinus could not be thoroughly examined and, since the patient was transferred to another army hospital, his further progress was not known.

Speculating on the source of the bleeding, the author concludes that it must have been one of the vessels traversing the pterygopalatine fossa via a fracture through the posterior wall of the sinus.

Kleitsch [121] states that treatment of fractures of the zygomaticomalar compound depends in part on the time elapsed since the injury. Repositioning within the first three or four days is usually easy, with little or no support required. However, if the fracture is seen after four days, it is more difficult to maintain the bones in the reduced position without external traction. Also, the type of fracture has much to do with the procedures indicated. Since most of these fractures involve the maxilla, one has to deal with displacement of the bulb and accumulation of organized blood in the antrum. Antrotomy offers the best approach for dealing with these conditions. The procedure recommended is the Caldwell-Luc approach, whereby the antrum cavity is exposed for removal of clots and repositioning of the fractured bones. The cavity is packed and the packing brought out in the nasal chamber via a large opening in the inferior meatus. If necessary, external traction may be employed by means of a screw inserted into the fractured bone with wires carried out to a suitable headband.

Mittermaier [122] states that the treatment of pathological sinus conditions associated with trauma to the skull, brain, and dura varies with the individual case, although certain fundamental principles apply in all instances. It is imperative that every effort be made to prevent infection of the endocranial structures from sinus foci and that adequate drainage and ventilation be established. At times it may be necessary to obliterate the frontal sinus and exenterate the ethmoids. On the other hand, if the frontal sinus is well expanded this may not be feasible and it may be necessary to conserve the cavity. In such cases it is important to avoid leaving any dead spaces, and also to provide a wide drainage channel into the nose. Also in such cases care must be exercised not to take away the supporting bony structures which form the boundaries of the sinus. The author points out the advantages of the usual curvilinear incision over the brow for exposure, even though there may be lacerations offering gaping wounds. These can usually be coordinated with the surgical incision. Proper exposure is important for adequate visualization of the frontal cavity and ethmoids. Several cases are cited, demonstrating individual problems and their solution.

MISCELLANEOUS

Falk [123] calls attention to the necessity for surgical exploration in cases of tertiary syphilis affecting the sinuses with encroachment on the orbit. In a typical case cited

121. Kleitsch, W. P.: Antrotomy for Fracture of the Malar Bone, Plast. & Reconstruct. Surg. **5**:176 (Feb.) 1950.

122. Mittermaier, R.: Beitrag zur operativen Versorgung gleichzeitiger Nebenhöhlen-Hirnhaut Hirnverletzungen, Ztschr. Laryng. Rhin. Otol. **28**:575 (Dec.) 1948.

123. Falk, P.: Über die Notwendigkeit operativer Eingriffe bei tertiarer tumorartiger Lues der Nebenhöhlen und der Orbita, Ztschr. Laryng. Rhin. **29**:376 (Aug.) 1950.

and by references to the literature, he indicates how tumor-like masses growing in the antrum and sphenoid may invade the orbit, causing exophthalmos and blindness from pressure on the optic nerve, and that an exenteration of the affected sinus in conjunction with antisyphilitic therapy may save the patient's vision. The operation is also indicated for the removal of bony sequestra and the release of pus due to secondary invaders. Histological sections of the case presented show typical syphilitic periarteritis and endarteritis in addition to lymphocytic and plasma cell infiltration.

Unger [124] states that hay fever is not a separate disease due to pollens but is an acute exacerbation of a chronic nasosinusitis that is induced by the excessive humidity of the season. He bases his thesis on an analysis of temperature and humidity readings in New York over a period of years, which show a consistently higher absolute humidity during the summer months. While the normal nose can adjust itself to the diminished requirement for moisture, the chronically infected nose is unable to cope with the discharge from the sinus and suffers the irritating effects of the discharge and the bacteria, thus giving rise to the typical "hay fever"symptoms. The author claims that careful examination of the sinuses in the off season will disclose the chronic infection.

25 E. Washington St.

124. Unger, M.: Hay Fever, Humidity and Sinusitis, New York J. Med. **50**:1727 (July 15) 1950.

Special Reports

HEARING AIDS ACCEPTED BY THE COUNCIL ON PHYSICAL MEDICINE AND REHABILITATION OF THE AMERICAN MEDICAL ASSOCIATION

As of April 1, 1952

Audicon Models 400 and 415

Mfr., National Earphone Co., Inc.
20 Shipman St.
Newark 2, N. J.

Audivox Model Super 67

Mfr., Audivox, Inc.—Successor to Western Electric Hearing Aid Division
123 Worcester St.
Boston 18

Aurex Models L and M

Mfr., Aurex Corporation
1117 N. Franklin St.
Chicago 10

Beltone Symphonette Model

Beltone Mono-Pac Model M

Mfr., Beltone Hearing Aid Company
1450 W. 19th St.
Chicago 8

Cleartone Model 500

Cleartone Model 700

Cleartone Regency Model

Mfr., American Sound Products, Inc.
1303 S. Michigan Ave.
Chicago 5

Dahlberg Model D-1

Dahlberg Junior Model D-2

Mfr., The Dahlberg Company
2730 W. Lake St.
Minneapolis 16

Dysonic Model 1

Mfr., Dynamic Hearing Aids, Inc.
149 Church St.
New York 7

Electrocar Model C

Mfr., American Earphone Co., Inc.
10 E. 43rd St.
New York 17

Gem Model V-35

Gem Model V-60

Mfr., The Gem Ear Phone Co., Inc.
50 W. 29th St.
New York 1

Maico UE Atomeer

Maico Quiet Ear Models G and H

Maico Model J

Mfr., The Maico Company, Inc.
21 N. 3rd St.
Minneapolis 1

Mears (Crystal and Magnetic) Aurophone Model 200

1947-Mears Aurophone Model 98

Mfr., Mears Radio Hearing Device Corp.
1 W. 34th St.
New York 1

Micronic Model 303

Micronic Model "Mercury"

Micronic Star Model

Mfr., Micronic Company
123 Worcester St.
Boston 18

Microtone Audiomatic T-5

Microtone Classic Model T-9

Microtone Model T-10

Microtone Model T612

Microtone Model 45

Mfr., The Microtone Company
Ford Parkway on the Mississippi
St. Paul 1

National Cub Model (C)

National Model D (Duplex)

National Standard Model (T)

National Star Model (S)

National Ultrathin Model 504

National Vanity Model 506

Mfr., National Hearing Aid Laboratories
815 S. Hill St.
Los Angeles 14

Otarion Model E-4

Otarion Models F-1, F-2, and F-3

Otarion Model G-2

Mfr., Otarion, Inc.
159 N. Dearborn St.
Chicago 1

Paravox Model D "Top-Twin-Tone"

Paravox Model J (Tiny-Myte)

Paravox Model XT ('Xtra-Thin)

Paravox Model XTS ('Xtra-Thin)

Paravox Model Y (YM, YC, and YC-7) (Veri-Small)

Mfr., Paravox, Inc.
2056 E. 4th St.
Cleveland 15

Radioear Permo-Magnetic (Multipower)

Radioear Permo-Magnetic (Uniphone)

Radioear All-Magnetic Model 55

Radioear Model 62 Starlet

Radioear Model 72

Mfr., E. A. Myers & Sons
306 Beverly Rd.
Mt. Lebanon
Pittsburgh 16
Distr., Radioear Corporation

Rochester Model R-1

Rochester Model R-2

Mfr., Rochester Acoustical Laboratories, Inc.
117 4th St., S. W.
Rochester, Minn.

Silvertone Model 103BM

Mfr., National Hearing Aid Laboratories
815 S. Hill St.
Los Angeles 14
Distr., Sears, Roebuck & Company
925 S. Homan Ave.
Chicago 7

Silvertone Model J-92

Mfr., Sears, Roebuck & Company
925 S. Homan Ave.
Chicago 7

Silvertone Model P-15

Mfr., Johnston Hearing Aid Mfg. Co.
708 W. 40th St.
Minneapolis 8
Distr., Sears, Roebuck & Company
925 S. Homan Ave.
Chicago 7

Solo-Pak Model 99

Mfr., Solo-Pak Electronics Corp.
Linden St.
Reading, Mass.

Sonotone Model 700

Sonotone Model 900

Sonotone Models 910 and 920

Sonotone Model 925

Sonotone Model 940

Sonotone Model 966

Mfr., Sonotone Corporation
Elmsford, N. Y.

Super-Fonic Hearing Aid

Mfr., American Sound Products, Inc.
1303 S. Michigan Ave.
Chicago 5

Televox Model E

Mfr., Televox Mfg. Company
1307 Sansom St.
Philadelphia 7

Telex Model 22

Telex Model 97

Telex Model 99

Telex Model 200

Telex Model 300-B

Telex Model 400

Telex Model 1700

Mfr., Telex, Inc.
Telex Park
St. Paul 1

Tonamic Model 50

Mfr., Tonamic, Inc.
12 Russell St.
Everett 49, Mass.

Tonemaster Model Royal

Tonemaster Cameo Model

Mfr., Tonemaster, Inc.
400 S. Washington St.
Peoria 2, Ill.

Unex Model A

Unex Midget Model 95

Unex Midget Model 110

Unex Models 200 and 230

Mfr., Nichols & Clark
Hathorne, Mass.

Vacolite Model J and J-2

Mfr., Vacolite Company
3003 N. Henderson St.
Dallas 6, Texas

Western Electric Models 65 and 66

Mfr., Audivox, Inc.—Successor to Western Electric Hearing Aid Division
123 Worcester St.
Boston 18

Zenith Model 75

Zenith Miniature 75

Zenith Model Royal

Zenith Model Super-Royal

Mfr., Zenith Radio Corporation
5801 W. Dickens Ave.
Chicago 39

(All the accepted hearing devices have vacuum tubes.)

Accepted hearing aids more than five years old have been omitted from this list for brevity.

TABLE HEARING AIDS

Aurex (Semi-Portable)

Mfr., Aurex Corporation
1117 N. Franklin St.
Chicago 10

Precision Table Hearing Aid

Mfr., Precision Hearing Aids
5157 W. Grand Ave.
Chicago 39

Sonotone Professional Table Set Model 50

Mfr., Sonotone Corporation
Elmsford, N. Y.

Abstracts from Current Literature

Ear

PSYCHOEDUCATIONAL STUDY OF CHILDREN BORN DEAF FOLLOWING MATERNAL RUBELLA IN PREGNANCY. EDNA SIMON LEVINE, A. M. A. Am. J. Dis. Child. **81**:627 (May) 1951.

In 1941, N. M. Gregg, of Australia, reported on 78 cases of congenital cataract in children of mothers who had had German measles. Since then various workers throughout the world have observed the dire effects of the exanthems on children born of mothers thus infected during gestation. Levine analyzes the behavior, intelligence, school achievements, acoustic patterns, and general health of 16 children born deaf after maternal rubella occurring during the first three months of pregnancy. The type of acoustic defect was "nerve deafness," but at least 8 of the group obtained "benefit from individual hearing aids." All children were up to standard height and weight. They had had the diseases common to childhood, with measles and chickenpox predominating. None had contracted rubella. Deaf children born of mothers who suffered maternal rubella are educable save for the major handicap of deafness, or they are mentally defective and not educable. The developmental peculiarities are usually manifest in early infancy, and, therefore, one may suspect that institutional care will be required. Suggestions as to possible means of prevention of these consequences have been set down by P. R. Patrick (*M. J. Australia* **1**:421, 1948). The inference is that these infections, which in the last analysis begin in the mucous membranes of the nose and throat, are of viral origin thus far unrecognized by present-day laboratory techniques.

I. W. VOORHEES, New York.

A PRELIMINARY INVESTIGATION OF THE EAR-CHOICE TECHNIQUE IN THRESHOLD AUDIOMETRY. E. THAYER CURRY and GEORGE H. KURTZROCK, J. Speech & Hearing Disorders **16**:340 (Dec.) 1951.

Twenty male college students were tested by both standard audiometric techniques and the experimental ear technique, which consists of a series of sweep frequency tests at descending sensation levels. With the attenuator kept at constant levels, stimulus was presented first to one ear and then to the other through a binaural headset, by changing the headphone choice switch on the audiometer. Ninety-eight per cent of the thresholds differed by 5 db. or less as measured by the two techniques, and no difference was greater than 10 db. No significant differences were found in an analysis of variance between the two methods. The ear-choice technique contains requisites of a good test for young children because of speed of administration, motivation, and general accuracy of response.

PALMER, Wichita, Kan.

SYMPATHECTOMY IN RELATION TO MÉNIÈRE'S DISEASE, NERVE DEAFNESS AND TINNITUS: A REPORT ON 110 CASES. E. R. GARNETT PASS, Proc. Roy. Soc. Med. **44**:760 (Aug.) 1951.

Acting upon the premise that Ménière's disease, idiopathic nerve deafness, and, in many cases, tinnitus, are caused by autonomic dysfunction, the author advocates upper thoracic sympathectomy with preganglionic section for their relief. He considers this an improvement over his former procedure of stellectomy and ligation of the vertebral artery. The operation recommended is a posterior extrapleural upper thoracic sympathectomy as based on the Smithwick operation, with the modification that only the second and third ganglia are decentralized. By leaving the first thoracic ganglion undisturbed Horner's syndrome is avoided. A block of the cephalic-sympathetic chain is first made either by (1) an injection of procaine into the stellate ganglion or (2) a paravertebral injection into the upper four or five thoracic ganglia. If tinnitus is subdued or relieved, and there is some improvement of hearing for low tones by air conduction, a case of Ménière's disease is considered suitable for operation. If tinnitus occurs without deafness or vertigo and is relieved by procaine block, the operation is "definitely" indicated. Of 88 patients with Ménière's disease, he reports 72 completely relieved of vertigo following the operation.

In cases in an early stage of development hearing was improved; if deafness was severe no improvement resulted. Sixteen cases of tinnitus are reported; procaine block gave temporary partial relief to eight, complete relief to five, and no relief to three. Thirteen patients were operated on, with a result "equivalent to that obtained by novocaine block." Nine patients with idiopathic perceptive deafness who showed audiometric improvement following procaine block had the operation performed on both sides, with subsequent improvement of hearing.

There is no discussion of undesirable side-reactions, complications, and sequelae following this operation, nor is there any explanation of failures.

DAY, Pittsburgh.

THE EFFECT OF SYMPATHETIC STIMULATION UPON THE COCHLEAR MICROPHONIC POTENTIALS. J. C. SEYMOUR and J. W. TAPPIN, Proc. Roy. Soc. Med. **44**:755 (Aug.) 1951.

Guinea pigs, rabbits, and cats were used for the experiments. Electric stimulation of the cervical sympathetic trunk was found to decrease the magnitude of the cochlear microphonic potentials with pure-tone stimuli between 1000 and 2000 cps. Sometimes there was observed a small but appreciable increase in the sizes of the cochlear microphonic potentials amounting to not more than one-eighth of their original values, lasting for 10 to 30 minutes before a gradual diminution in size resulted from further stimulation with the cochlear microphonic potentials reaching a level between one-half and two thirds of the original values. There was no distortion of the sine-wave form. The decrease of the potentials is probably due to diminution of the cochlear blood supply resulting from vasoconstriction. If sympathetic hypertonus is an etiologic factor in Ménière's disease, the deafness during the attacks might be accounted for.

DAY, Pittsburgh.

DEAF-MUTISM IN CHILDREN. E. FASSER, South African M. J. **25**:145 (March) 1951.

The author notes that in the vast majority of cases of deaf-mutism, the pathogenesis is genetic in origin, with the mutism secondary to the deafness. In a minority of cases the cause is infection in the early postnatal period. Rubella in the mother in the early months of pregnancy plays a minor and relatively insignificant role. Diagnosis should be made as early as possible, and aphasia should be distinguished from deafness.

Instruction in lip reading, individual tutoring, use of hearing aids, and social aid in the family should be started as early as possible.

MCGUIGAN, Evanston, Ill. [A. M. A. Am. J. Dis. Child.].

REPORT AND RESULTS OF THIRTY-THREE CASES FOR SURGICAL CORRECTION OF CONGENITAL MALFORMATIONS OF THE AURICLE WITH ATRESIA OF THE EXTERNAL AUDITORY CANAL. MARCEL OMBREDANNE, Ann. oto-laryng. **68**:5, 1951.

Thirty-three cases of congenital malformation of the auricle with complete atresia of the auditory canal are reported occurring mainly in children from 7 years of age and upward but also in a few adults.

The technique followed consisted mainly in the reconstruction of the malformed auricle by plastic surgery, with the use of cartilaginous grafts or acrylic implants. Then an auditory canal was shaped, the external extremity of which was placed in the center of the newly formed auricle and the walls of which were lined with epithelium from a full thickness graft and a pedunculated flap. The inner extremity of this canal was placed over the previously fenestrated external semicircular canal.

This procedure has proved to be very difficult, but has been encouraging in that 22 good results, 8 mediocre results, and 3 failures from a functional point of view have been obtained. In instances with complete aplasia and with complete absence of the middle ear and ossicles encouraging results were obtained in seven instances.

VIOLE, Los Angeles.

CURE OF TWO CASES OF SUPERACUTE OTOGENOUS OSTEOMYELITIS OF THE TEMPORAL BONE IN YOUNG CHILDREN. W. SCHMIDLI, Schweiz. med. Wchnschr. **81**:461 (May 19) 1951.

The cases of two children are reported, one 6 months old and the other 2 years old. In both, otitis media, of relatively short duration and with foul-smelling discharge, suddenly gave

way to very severe septicopyemic symptoms and local edema. Upon operation an unexpectedly severe destruction of bone in the mastoid and temporal bone was observed, and in contrast there was a rather slight destruction of the tympanic membrane and the middle ear. In spite of the absence of an epidural abscess, a superacute progressive osteomyelitis was encountered, and the diagnosis was confirmed upon histological examination. From the first patient a nonhemolytic Streptococcus was cultured. This patient was treated successfully with radical surgery and penicillin. The other responded to radical surgery, penicillin, and "elkosin" (a sulfonamide).

AMBERG, Rochester, Minn. [A. M. A. Am. J. Dis. Child.].

REVISION OF THE FENESTRA. FRANCISCO ANTOLI-CANDELA and FERNANDO ANTOLI-CANDELA, Acta oto-rino laring. Ibero-Am. **2**:*332*, 1951.

The authors discuss the problem of osteogenesis and the indications and contraindications for the revision of the fenestra. They feel that the fenestra should not be revised when (1) there has not been any appreciative gain in hearing following the original operation; (2) if with an increase of the lower frequencies there is no improvement in the conversational range; (3) if after good postoperative improvement there is a rapid loss in a period of three to six weeks (this indicates a fibrosis); (4) when good results have been obtained, symptoms of edema of the labyrinth occur with a marked fluctuation in the hearing acuity; (5) when the bone conduction at the time of revision shows a marked decrease in comparison to that prior to the fenestration (this is a symptom of progressive cochlear degeneration), and (6) in cases of malignant otosclerosis with a rapid type of deafness and when the postoperative improvement is not maintained. On the other hand, the revision should be performed when (1) there is a suspicion that the operation was not done correctly, the fenestra is small, the plastic toilet is poor, and there are bony particles overlying the labyrinth; and (2) when the patient has had a frank gain, with a positive fistula, but after six to eight weeks there appears a slight loss of hearing and the fistula test remains positive. The authors present a case in which the fenestration was performed with a gain of 25 db., particularly in the conversational frequencies. However, two months after the operation the patient began to notice a decrease in his hearing acuity, which continued until the hearing reached the preoperative level. The fistula was revised, and it was found to be filled with regenerated bone. This was carefully removed, and the ultimate result was a net gain of 23 db. above the preoperative level. This hearing was maintained for at least six months following the revision.

PERSKY, Philadelphia.

ON OBJECTIVE TINNITUS AND ITS RECORDING. H. ENGSTRÖM and W. GRAF, Acta otolaryng., Supp. 95, p. 127, 1950.

The authors report 10 cases of objective tinnitus. The causes and pathology involved are discussed. The vascular nature is covered. In these instances the desirability of recording the bruit, the methods of auscultation, and the role of angiography are noted. While there may be a continuous objective vascular murmur without vascular lesion, there is a presumption that one is present, and its presence should be disproved. Thus if proper study and auscultation of the skull are combined with phonophotographic recording and angiography, arteriovenous aneurysm may be demonstrated. Some of these aneurysms are amenable to surgical treatment, with the expectation of cure.

ROBERT LEWY, Chicago.

VARIOUS MOVEMENTS OF THE HUMAN EYE ON ROTATION ABOUT DIFFERENT AXES. L. B. W. JONGKEES and J. HULK, Acta oto-laryng. **38**:274 (June) 1950.

The authors use a smoothly driven and completely turning room, which encloses both the patient and the observer, to test the activity of the semicircular canals. Frenzel lenses are used to increase the ability to observe nystagmus, and the patient is placed in various positions to determine activity of the canals. With this equipment they are able to rotate a patient upon any axis. Basing the conclusion upon their observations, they state that Flourens' law is true, i. e., that stimulation of a semicircular canal causes movement in the direction of that canal. They declare that the statement that "each canal causes a nystagmus in its own plane" is only

a misquotation and is not true. The form of nystagmus depends upon the direction of gaze as well as the axis of rotation in relation to body position. Gradual changes in the relation of the body to the axis of rotation produce gradual changes in eye movement. The customary examination of rotatory and vertical nystagmus is not a physiological procedure.

ROBERT LEWY, Chicago.

RUBELLA AND DEAF-MUTISM IN SWEDEN. BERTEL IVSTAM, Acta otolaryng. **39**:380 (Oct.) 1951.

An analysis was made of 538 pupils attending a school for deaf mutes in Sweden. There were in the series 261 children with deaf-mutism of doubtful origin. Of this group 12% of the mothers had rubella within the first four months of pregnancy. In the years (1937 and 1941) when rubella was common the mothers of more than 10% of children had rubella. In Sweden the apparent incidence of deaf-mutism from rubella runs about 3-5%, the total malformations from this cause 10-20%.

The frequency of these difficulties justifies deliberate infection of young girls with rubella and the use of convalescent serum or gamma globulin to pregnant women exposed to rubella.

ROBERT LEWY, Chicago.

THE CAVITIES AFTER RETROAURICULAR EAR OPERATIONS WITH SPECIAL REFERENCE TO THE SIGNIFICANCE OF THE PRIMARY FACTORS. OTTO JEPSON and ERIC ZWERGIUS, Acta otolaryng. **39**:388, Oct., 1951.

In the 1928-1946 operative period 311 patients were observed, and of this group 204 were reexamined after a period of observation varying from 4 to 22 years. From this study comes the observation and conclusion that the primary ear pathology which indicated the surgery bears no important relationship to the eventual quality of the new cavities created surgically. Ears were dry in 48% of ears operated on for cholesteatoma and in 42% of granulating ears. Results were poorer in the radical cavities of children than in adults. There was a general tendency to poorer cavities when the dura had been exposed. The variety and character of the plastic procedure and whether a radical or modified radical operation was performed fails to influence the end-result.

ROBERT LEWY, Chicago.

HISTOLOGIC STUDIES OF ENDOLYMPH SECRETION AND RESORPTION IN THE MIDDLE EAR. ARNO SAXEN, Acta otolaryng. **40**:23 (Jan.) 1951.

New staining and histological methods were used in these studies. A combined celloidin-paraffin method was used. This made a very thin section possible, 4 to 6μ in diameter. The authors feel that they have demonstrated that the cochlear duct and the semicircular canals contain cells for both the secretion and the transport of endolymph. The epithelium of the stria vascularis has this function in the cochlear duct, or at least for substances that pass into the endolymph. Endolymph is formed chiefly from perilymph and indirectly from cerebrospinal fluid. Blood vessels and cells of the sulcus spiralis with long protoplasmic filaments aid in resorption.

The secretory epithelium of the semicircular canals consists of epithelial cells of the crista ampullaris, the planum semilunatum. Resorption from the static labyrinth occurs in epithelial cells of the endolymphatic duct and sac.

ROBERT LEWY, Chicago.

ETIOLOGY OF DEAFNESS IN YOUNG CHILDREN. JOHN E. BORDLEY and WILLIAM G. HARDY, Acta otolaryng. **40**:72 (Jan.) 1951.

Using the Galvanic skin response, the authors were able to test the hearing in quite young children and in many instances to establish diagnosis. They felt that for one-third of the group of 296 children a satisfactory diagnosis could not be made. In other instances there was difficulty of choice between several etiologic factors. Eighty-eight of the group had been exposed to the causative factor of their deafness by the time delivery was completed. Thus from a point of view of prevention of birth injuries and erythroblastosis many of these instances of deafness

might have been avoided; over half of the children should have started life with normal hearing. Add to this the group which had meningitis, measles, and middle ear disease, and the number of fairly preventable hearing losses becomes larger. One material help may be from immunization for rubella before pregnancy.

ROBERT LEWY, Chicago.

OTITIS IN SMALL CHILDREN DUE TO HEMOPHILUS INFLUENZAE. GUNNAR BJUGGREN and GÖSTA TUNEVALL, Svenska läk-tidning. **47**:433, (Feb. 24) 1950.

The authors have studied bacteriologically and clinically 178 children suffering from otitis. They stress the high incidence of Hemophilus influenzae otitis in children under 3 years of age. The otitis usually is successfully treated with sulfonamide compounds and penicillin but has a great tendency to relapse, probably due to remaining foci in the nose and its cavities.

WALLGREN, Stockholm, Sweden [A. M. A. Am. J. Dis. Child.].

Pharynx

VESICULAR PHARYNGITIS: ITS RELATIONSHIP TO THE COXSACKIE GROUP OF VIRUSES. J. K. DAVID JR., DANIEL LEAVITT and BEATRICE F. HOWITT, Pediatrics **8**:672 (Nov.) 1951.

During the summers of 1949 and 1950, a number of children in Jacksonville, Fla., were observed who presented the following clinical picture. The child, usually under 5 years old, became suddenly ill with fever, malaise, and anorexia. Examination revealed vesicular or aphthous lesions on the soft palate and anterior faucial pillars. The duration of the fever was brief, usually less than 48 hours. The clinical course and the appearance of the pharyngeal lesions were strikingly uniform in these patients. A virus agent pathogenic for suckling mice was isolated from the throat secretions of 12 of 13 patients showing this clinical picture. This agent proved to be similar, but of a different serologic type, to the virus first isolated in 1948 by Daledorf and Sickles and later designated as Coxsackie virus. These results strongly suggest a causal relationship between the viral agent recovered and the clinical disease.

FROM THE AUTHORS' SUMMARY [A. M. A. AM. J. DIS. CHILD.].

X-RAY THERAPY OF ADENOIDS IN INFANTS. R. CLEMENT, R. BOURDON, and MOULINARD, Pédiatrie **38**:575 (No. 6) 1949.

The authors have used x-ray therapy in cases of hypertrophy and infection of the adenoids in infants who presented breathing or feeding difficulties for a number of years, and they report good results and no damaging effects. They prefer this method to surgery or radium therapy. They checked their results by roentgenograms with a radiopaque medium.

GLASER, Jerusalem, Israel [A. M. A. AM. J. DIS. CHILD.].

Larynx

LARYNGEAL STRIDOR AND HYPERTROPHIED THYMUS. J. A. DE LA TORRE, Bol. méd. Hosp. inf., México **7**:887 (Dec.) 1950.

Congenital inspiratory stridor in a 5-month-old boy is reported. Roentgenologic study, both plain and with pneumomediastinum, revealed moderate hypertrophy of the thymus. Endoscopy disclosed flaccidity of the right arytenoid cartilage and slight tracheal stenosis. After irradiation the stenosis disappeared and there was a prompt and definitive improvement of the stridor. A control laryngoscopy showed the persistence of the laryngomalacia.

FROM THE AUTHOR'S SUMMARY [A. M. A. AM. J. DIS. CHILD.]

TREATMENT OF PSEUDOCROUP. NILS L. MALMBERG, Svenska läk.-tidning. **47**:797 (April 6) 1950.

A report of 980 patients with laryngismus stridulus (pseudocroup), treated at the Municipal Hospitals, Gothenburg, Sweden, from 1938 to 1949, is presented. In 34 cases tracheotomy was required and performed, with 15 fatalities. Of 12 patients operated upon in 1949 only 2 died. The total mortality rate was 2%. The importance of intensive treatment with the sulfonamides and

penicillin, early tracheotomy in severe cases, and careful postoperative supervision is stressed. If respiratory difficulties arise after tracheotomy, bronchoscopy with suction should be performed and roentgenograms made of the lungs in order to detect or exclude pneumothorax.

WALLGREN, Stockholm, Sweden [A. M. A. AM. J. DIS. CHILD.].

HEMOPHILUS INFLUENZAE B LARYNGITIS. JAN BARR, Svenska läk.-tidning. **47**:806 (April 6) 1950.

Of 421 patients with infectious laryngitis treated between 1939 and 1948 at the Fever Hospital in Stockholm, 35 had the type called malign fulminant (acute) laryngotracheitis. Among these 35 there were 13 with supraglottic edema. In one case Hemophilus influenzae was found. Early tracheotomy is recommended.

WALLGREN, Stockholm, Sweden [A. M. A. AM. J. DIS. CHILD.].

Nose

CHRONIC NASOSINAL AFFECTIONS IN CHILDHOOD. AUGUSTO LATORRE AGUERO, Rev. chilena pediat. **21**:409 (Sept.) 1950.

Chronic disease of the sinuses is frequently found in childhood, although generally the correct diagnosis is not made and it is classified as chronic rhinitis. From the pathological standpoint one can distinguish three different types of chronic sinus conditions: the hyperplastic form, the purulent or bacterial type, and the mixed or hyperplastic-purulent type.

The hyperplastic form is characterized by a thickening of the mucosa of the perinasal cavities, without a concomitant purulent secretion. Apparently, in the great majority of the cases, this type is of an allergic nature, and the symptoms are those characteristic of this condition: nasal obstruction, rhinorrhea, spasmodic sneezing, and epiphora. The purulent type is characterized by an abundant purulent rhinorrhea. This form frequently gives rise to bronchopulmonary complications, especially to a chronic bronchitis, owing to the fact that the lower respiratory tree receives the nasal secretions that descend by the rhinopharynx to the trachea and bronchi, especially during sleep. The mixed form is a combination of the above-mentioned forms. Diagnosis is based principally on history, anterior and posterior rhinoscopy, puncture and lavage of the maxillary sinus, and roentgenologic examination. Sometimes the diagnosis must be based on other examinations, such as elimination of contrast mediums or investigation of the eosinophiles in the nasal secretion.

The treatment of the hyperplastic allergic forms should be done by an otolaryngologist in collaboration with an allergist. In the purulent forms treatment should aim at trying to establish a proper drainage, relieve nasal obstruction, and eliminate all other foci. Often these purulent forms must be treated as conservatively as possible, an attempt being made only to obtain good drainage by simple procedures. Only in exceptional cases and when dentition is practically complete (14 to 16 years old) can more radical surgery, such as the Caldwell-Luc or the Ermiro de Lima techniques be used. The sulfonamides and antibiotics are of little value in the chronic sinus conditions whether administered orally, intramuscularly, or locally, in contradistinction to the response in the acute forms, in which the use of these drugs is followed by great improvement.

FROM THE AUTHOR'S SUMMARY [A. M. A. AM. J. DIS. CHILD.]

FUNCTIONAL TESTS FOR THE MAXILLARY SINUS. T. DAITO, and M. ISHIKAWA, Japanese J. Otolaryng. **23**:241 (June) 1951.

A varying amount of radiopaque substance was introduced into 200 maxillary sinuses; afterward, radiological examination was made to determine the ability of each sinus to empty its contents.

Both normal and pathological sinuses were under investigation. The latter included sinuses with acute and chronic infections, sinuses with argyrosis, sinuses in postoperative states in which the mucosal lining was partially or totally removed, and sinuses deprived of air current after a total laryngectomy.

As was previously reported, the most important means of evacuating the antral cavity is by cilliary action. A normal, unhindered air current within the sinus activity is another important factor in expulsion of foreign substances.

HARA, Los Angeles.

Miscellaneous

USE OF ANTIBIOTICS IN OTOLARYNGOLOGY. F. W. DAVISON, Ann. Otol. Rhin. & Laryng. **60**:207 (March) 1951.

Basing his conclusions on his experience during the past six years in the study of penicillin-sensitivity cultures of secretions from patients ill with various types of otolaryngic infections, Davison states that the Gram-positive cocci causing these infections have become relatively resistant to the action of penicillin. Therefore, for effective therapy in such infections, much larger doses of the antibiotic drugs now are necessary.

According to present practice, acute sinusitis necessitates daily doses of 4,800,000 units of penicillin procaine, or aureomycin or terramycin, 3 to 4 gm. daily. Treatment is continued for seven days. Some of the author's best results have been obtained by using dihydrostreptomycin, 0.5 gm. every six hours, and penicillin procaine, 400,000 units every three hours, for 7 to 10 days. External surgical drainage of acute frontal sinusitis still is necessary on occasion.

Chronic sinusitis requires larger doses of antibiotics for cure. In some cases, a dose of 6,400,000 units of penicillin daily was necessary. Puncture and lavage of chronically infected antra should be done when indicated. This applies as well to removal of nasal polyps and performance of intranasal antrostomy.

In certain cases of acute otitis media myringotomy should be done early, but the condition usually clears up satisfactorily after the patients receive adequate doses of penicillin or other antibiotics mentioned above. Best results are obtained if treatment is continued for 48 hours after the aural discharge ceases. Whereas the incidence of surgical mastoiditis in 1937 was 58.9% of cases of otitis media and acute mastoiditis, the present incidence is 5.5%. This decreasing incidence of mastoid surgery has not resulted in an increasing incidence of complications.

Davison believes that acute pharyngitis and acute tonsillitis respond more rapidly to smaller doses of antibiotics than does acute middle ear infection. Dihydrostreptomycin in large doses in addition to penicillin should be given to children having acute laryngotracheobronchitis and adults with acute epiglotitis due to the frequent presence of Hemophilus influenzae in such infections. In children, 400,000 units of fortified penicillin procaine every six hours plus 20 mg. of dihydrostreptomycin per pound (0.5 kg.) of body weight daily is considered adequate antibiotic therapy.

Topical application of the antibiotics is not considered worth while, the intramuscular routes being preferred.

STEELE, Kansas City, Kan.

THYROID DYSFUNCTION IN RELATION TO RHINOLOGIC DISEASE. A. R. HOLLENDER, Eye, Ear, Nose & Throat **30**:477 (Sept.) 1951.

There has been a revival of interest in thyroid dysfunction as related to rhinologic disease. Several investigators have reported results of studies on this subject in the past few years. The subject is not new, however, as Novak and other workers had attempted to define the relationship in the early twenties.

The fallacy that the results of basal metabolism tests can be entirely depended upon to classify patients in the category of hypothyroidism has been emphasized by endocrinologists. There is a distinct difference between hypothyroidism as such and hypometabolism, the latter being a broad term referring to endocrine rather than to hypothyroid dysfunction. Even some allergists are in agreement that in a small group of patients suffering from nasal allergic symptoms there is an endocrine-allergy relationship, and on this basis thyroid therapy often proves beneficial. Thyroid dysfunction may be a prominent cause of certain nonallergic nasal conditions which are characterized by definite subjective and objective signs and symptoms.

Thyroid therapy is safe if it is employed with caution, is controlled by metabolism tests, and is administered under medical supervision. In studying patients who may fall in the sphere with

which this discussion is concerned, the rhinologist should not lose sight of the fact that the serum cholesterol is elevated and bears a reciprocal relation to the basal metabolic rate. The rhinologist in his dealing with the problem of nasal disease should remember that the day of empirical topical remedies has passed and that more rational nasal therapy involves consideration of possible somatic factors and their correction.

JENNES, Waterbury, Conn.

ALLERGY AS A FACTOR IN CHILDHOOD SINOBRONCHITIS. WALTER C. PRICE and IRWIN A. SOLOW, J. Allergy **22**:4 (Jan.) 1951.

A group of 62 children with family history or patient history of acute or chronic allergy was selected from a group of 331 children admitted to the hospital with a history of chronic respiratory disease. Roentgenographic evidence of sinobronchial disease was present in 64% of the children under 5 years of age. In 57% of the allergic children who had positive skin-test reactions, sinobronchitis was noted. A ready susceptibility to lower-respiratory-tract infection was evident when there was a familial factor of allergy together with positive skin-test reactions.

HOYER, Cincinnati [A. M. A. Am. J. Dis. Child.].

MEASURING THE SEVERITY OF STUTTERING. DON LEWIS and DOROTHY SHERMAN, J. Speech & Hearing Disorders **16**:320 (Dec.) 1951.

The severity of stuttering was judged by 30 elementary psychology students on 240 nine-second samples of stuttering speech. Dividing the range of severity into eight intervals, three "expert" judges selected 96 samples with small Q-values to cover the entire range of severity. These 96 samples were presented to 106 elementary psychology students. Scale values obtained from judgments by Group 1 were compared with judgments from Group 2. Reliability was high.

PALMER, Wichita, Kan.

CONSIDERATION OF THIAMIN SUPPLEMENT IN PREVENTION OF STUTTERING IN PRESCHOOL CHILDREN. L. L. HALE, J. Speech & Hearing Disorders **16**:327-333 (Dec.) 1951.

Ten milligrams of thiamine hydrochloride was given three times daily to stutterers of preschool age and a placebo to a control group of preschool stutterers. After one month, treatment was reversed and observation continued for another month. Neither the clinicians nor the parents knew which preparation the child was receiving. Observable speech improvement occurred in 55% of all patients treated with thiamine. Improvement occurred primarily in the first two weeks of treatment. Of the 2- and 3-year-old children, 80% made improvement; of the 4-year-old children, 50%. Hale believes that thiamine may be helpful in the prevention of stuttering in preschool children.

PALMER, Wichita, Kans.

THERAPY FOR SPEECH DEFICIENCIES RESULTING FROM ACUTE BULBAR POLIOMYELITIS INFECTION. E. E. BAKER JR. and M. A. SOKOLOFF, J. Speech & Hearing Disorders **16**:337 (Dec.) 1951.

Nineteen patients returning to the department of physical medicine and rehabilitation of Bellevue Hospital for periodic follow-up examinations subsequent to acute bulbar poliomyelitis showed a characteristic speech aberration due essentially to flaccid paralysis of the velar musculature. Therapy undertaken to correct the defect produced satisfactory results in 12 patients: four attained a marked degree of improvement, while eight showed degrees of improvement varying from marked to slight. The techniques used were blowing exercises, panting and yawning exercises, and massage of the velum. It was felt that the patients who were not progressing showed certain emotional patterns which interfered with therapy.

PALMER, Wichita, Kans.

TIME-PATTERNS OF SPEECH IN NORMAL SUBJECTS: II. MARCEL VERZEANO, J. Speech & Hearing Disorders **16**:346 (Dec.) 1951.

Frequency distributions of the units of speech of eight subjects were brought together into an average distribution and studied for time delay and time patterns of speech with the aid of a mathematical analyzer. For most delays in speech the tendency is toward random distributions. Departure randomness, however, is rather pronounced at very short delays on one hand and

relatively long delays on the other. Actual distribution curves show a number of unexplained irregularities. Shorter units and, more particularly, the units which had an average duration of 1.5 second were more numerous than would be expected from the theoretical distribution. Shorter words and shorter expressions may be considerably more numerous than longer ones, and there may be a tendency to stop for a significant pause after many of the shorter words.

PALMER, Wichita, Kans.

SPEECH DISORDERS AMONG EUROPEAN MILITARY PERSONNEL IN WORLD WAR I: PART I: H. BLOOMER, and H. SHOHARA, J. Speech & Hearing Disorders **16**:351 (Dec.) 1951.

Bloomer and Shohara present a review of the European military medical literature on the speech disorders arising from war, published in German, French, Italian, and British medical journals or other scientific publications between 1914 and 1920. Part I reports the number of cases of aphonia and dysphonia and general techniques used. There is an extensive bibliography.

PALMER, Wichita, Kans.

GRADUATE THESES IN SPEECH AND HEARING DISORDERS—1950. F. H. KNOWER, J. Speech & Hearing Disorders **16**:367 (Dec.) 1951.

This is a report of the graduate theses in speech and hearing disorders accepted by American colleges and universities in the year 1950.

PALMER, Wichita, Kans.

COMBINATIONS OF ANTIBIOTICS IN TREATMENT OF INFECTIOUS DISEASES. WILLAM E. WELLMAN, Minnesota Med. **34**:537 (June) 1951.

The author cites several diseases in treatment of which he feels that a combination of antibiotics should be used. Patients with brucellosis are best treated by a combination of aureomycin and dihydrostreptomycin. In some cases enterococcal endocarditis can be cured by using a combination of penicillin and dihydrostreptomycin. In cases of bacteremia, peritonitis, and meningitis when the organism is not known, a combination of aureomycin or terramycin with dihydrostreptomycin is indicated. One should remember that terramycin does not diffuse into the cerebrospinal fluid. The author concludes, first, that a definite synergism between penicillin and dihydrostreptomycin is established. Second, there appears to be an antagonistic effect between penicillin and aureomycin or chloramphenicol. Third, certain bacteria made resistant to aureomycin, to terramycin, and to chloramphenicol showed an increased resistance to all three but not to dihydrostreptomycin.

STOESSER, Minneapolis [A. M. A. AM. J. DIS. CHILD.]

EFFECTS OF ADENOTONSILLECTOMIES IN RESPIRATORY ALLERGIES. B. GORELIK, Ann. oto-laryng. **68**:46, 1951.

The following conclusions were derived from a review of 93 cases of respiratory allergies in which adenotonsillectomies had been performed: 1. No improvement was noted among asthmatic patients or persons with vasomotor rhinitis. 2. Vasomotor rhinitis was aggravated in 16 persons, with severe tracheal cough in 7 adults. 3. Vasomotor rhinitis was precipitated in 18 patients who did not have such symptoms preoperatively. 4. The postoperative return of lymphoid tissue is not of infrequent occurrence in allergic patients who have undergone operation.

VIOLE, Los Angeles.

TREATMENT OF PURULENT FORMS OF MENINGITIS IN CHILDHOOD ACCORDING TO PRINCIPLES IN FORCE AT PRESENT. HELMUT WALENZ, Med. Klin. **44**:1397 (Nov. 4) 1949.

A total of 52 children with purulent meningitis were treated over a period of four years. The bacteria involved were meningococci, pneumococci, staphylococci, streptococci; and Hemophilus influenzae and Salmonella.

Meningococcus meningitis was treated with sulfonamides. For patients with Waterhouse-Friderichsen syndrome, or those in whom the fever did not yield promptly, a combination of

sulfonamide with penicillin was used. Of 23 patients, 7 died, including those admitted in a moribund state. Of the 19 patients with pnemococcic meningitis, 13 were below 1 year of age. Of the 19, 9 came in moribund and died; of the others, 2 could be saved with combined sulfonamide and penicillin therapy. All five patients with influenzal meningitis died in spite of sulfonamide, penicillin, and streptomycin therapy. Three of these patients were less than 1 year old; the others were 12 and 14 months. For Salmonella infections a combination of sulfonamide and streptomycin is recommended. Of four patients with meningitis due to Staphylococci two were cured by sulfonamides alone, the other two by sulfonamides and penicillin, a combination recommended for Streptococcus meningitis also. AMBERG, Rochester, Minn. [A. M. A. AM. J. DIS. CHILD.]

ABSCESS FOCUS IN PERITONSILLAR ABSCESS. R. TAKAHASHI, Japanese J. Otolaryng. **23**:453-455 (Nov.) 1951.

Tonsillectomies were performed during the acute stage of quinsy. The tonsils were then examined, both macroscopically and microscopically. Takahashi states that in the majority of instances tonsillar tissues are partly involved in the abscess but the walls of this focus are composed for the most part of infiltrated capsular tissues.

In some instances the location of the abscess was what he terms intracapsular, and at times the abscess extended to an extracapsular structure.

Takahashi does not agree with the observation that the abscess is wholly extracapsular in origin or with that which holds that the abscess is limited to intracapsular and intertonsillar extent.

HARA, Los Angeles.

DOUBLE OCCURRENCE OF PRIMARY CANCERS ON WALL OF MAXILLARY CAVITY AND RECTUM. H. KOBAYASHI, J. Oto-Rhino-Laryng. Soc. Japan **54**:45 (Oct.) 1951.

Kobayashi reviews the Japanese otolaryngological literature for instances of multiple primary neoplasms occurring simultaneously. He cites Ono, who reported squamous cell carcinoma of the esophagus and tongue; Kuritas, who reported on squamous cell carcinoma occurring in the faucial tonsil and esophagus, and Sasaki and Kondo, who reported epithelioma and sarcoma of the mandible and hard palate. Kobayashi adds to these a report of his own case of epithelioma of the left maxillary sinus and adenocarcinoma of the rectum. The patient was a 60-year-old woman. The growth in the antrum was removed by the Denker operation followed by intracavital irradiation totaling 2,900 mg.-hr. On the 14th postoperative day a strawberry-like rectal tumor the size of a hazelnut was removed by resection. No metastasis was found. The patient left the hospital apparently well. This is the fourth case in which double primary cancer involving an otolaryngologic site has been recorded.

HARA, Los Angeles.

EXPERIMENTAL STUDY ON THE AIR VOLUME EXPIRED DURING PHONATION. H. OZAKI, J. Oto-Rhino-Laryng. Soc. Japan **54**:497 (Oct.) 1951.

Since the beginning of the present century numerous attempts have been made to measure the volume of air expired during the process of phonation. Notable among those recorded were the reports of Roudet, Rouselot, Gutzmann, Zwaardemaacker, Kickhefel, Fröschels, and Hulse, but because of the lack of instruments necessary for the measurement of the intensity of the sound there was left much to be desired in their experiments.

Ozaki used a hot-wire anemometer in measuring the volume of expired air. He was not only able to measure the average volume of the expired air but was able also to measure the volume during the period when the voice is actually produced. He used 10 males and 8 females, and 1 subject who was a trained vocalist.

He summarizes the experiment, stating that (1) the flow of expired air is not uniform; there is a definite ebb and flow after the beginning of phonation, and (2) in trained vocalists such a fluctuation is less marked.

HARA, Los Angeles.

News and Comment

FIFTH INTERNATIONAL CONGRESS OF OTO-RHINO-LARYNGOLOGY

Selected subjects on the program for the combined sessions of the Fifth International Congress of Oto-Rhino-Laryngology, to be held in Amsterdam, Netherlands, June 8-15, 1953, will be as follows:

TUMORS OF THE BRONCHUS

A. Soulas et P. Mounier-Kuhn	Tumeurs benignes des bronches
L. Pietrantoni	La clinique et l'endoscopie des cancers des bronches
Louis H. Clerf	Cytology of Tumors of the Bronchus

AUDIOLOGY

C. S. Hallpike	Physiologic Problems of Audiology
George E. Shambaugh, Jr.	Clinics of Audiology
S. R. Silverman	Social Aspects of Audiology

ALLERGY

G. Dohlman	Theory of Allergy
French K. Hansel	Methods of Allergic Examination
R. Melchior	L'hypersensibilité d'origine non-allergique

DR. GLICK AWARDED PRIZE

Dr. Harry N. Glick was awarded first prize for his scientific exhibit, entitled The Anatomy and Surgery of the Temporal Bone, at the convention of the Third Pan-American Congress of Otolaryngology and Bronchoesophagology, which was held in Habana, Cuba, Jan. 20-24, 1952. Dr. Glick is assistant professor of clinical otolaryngology at Washington University Medical School.

Books

Diseases of the Ear, Nose and Throat: A Textbook of Clinical and Laboratory Procedures. By Georges Portmann, M.D., professor of oto-rhino-laryngology at the University of Bordeaux. Translated by Fernand Montreuil, M.D., and Jules G. Waltner, M.D., Columbia University College of Physicians and Surgeons. Price, $20.00. Pp. 728, with 666 illustrations and 11 plates. Williams & Wilkins Company, Mt. Royal and Guilford Aves., Baltimore 2, 1951.

This book is an outgrowth of the author's teaching over many years and in many countries. Because of the author's background and experience this volume is of interest to the general practitioner and the specialist alike. The contents of the book are arranged so that the anatomy, physiology, and symptomatology are separately discussed in each section of the book. The sequence of subjects is as follows: auricular apparatus; nasal cavities; mouth and pharynx; larynx, trachea, bronchi; esophagus, and laboratory methods in otolaryngology. The material is arranged in 22 chapters. The book does not discuss at any great length treatment of diseases of the ear, nose, and throat. The paper is good; the subject matter is well written, and the illustrations are adequate. Because of the viewpoints that it presents, it is recommended.

Arachnoidites opto-chiasmatiques et maladie neuro-vasculaire. By J. N. Taptas, M.D., and T. Dimopoulos, M.D. Price, not given. Pp. 110. Masson & Cie, 120 Boulevard Saint-Germain, Paris, 6e, 1949.

Alergie et troubles vasomoteurs de la muqueuse nasale et sinusienne. By R. Melchior, M.D. Price, not given. Pp. 170. Masson & Cie, 120 Boulevard Saint-Germain, Paris, 6e, 1950.

These two recent monographs from overseas reflect the concepts, and the type of work that is being performed, in the medical centers of Europe. The first of these two works is divided into two parts: The first part discusses general principles of the subject, and the second deals with the subjects of the anatomy, the relationships of nerves, cerebrospinal fluid, and diagnostic and therapeutic problems. There is an exhaustive bibliography covering both parts of the text.

The second book of this group is, like the first, a scholarly presentation of the subject of allergy and vasomotor disturbances, as a review of the bibliography and table of contents reveals. The subject matter again is arranged in two parts. The first part, dealing in generalities, discusses history, experimental anaphylaxis, infectious allergy, nonspecific hypersensitivity, and human allergy. The second part is composed of discussions of various aspects of the specific problems of vasomotor disturbances and allergy. One interested in foreign viewpoints and scholarship and able to understand French would find his time well spent in reading these books.

Plastic Surgery of the Nose. By James Barrett Brown, and Frank McDowell. Price, $15.00. Pp. 437, with 331 photographs and 48 color photographs. The C. V. Mosby Co., 3207 Washington Blvd., St. Louis 3, 1951.

As the title implies, this book has been written by plastic surgeons, and it is devoted exclusively to the subject of plastic surgery. The selection of topics is based mainly on the experience of the senior author, which includes operations on both civilian and military patients. Cosmetic surgery is emphasized, as well as the correction of deformities and the repair of injuries. The customary methods of preliminary examination and preparation of the patient are described. Means for determining the design for the desired operative results are sketched, including measurements of esthetic contour, casts, and photographs of the face. Directions are given for choice of special instruments to be used in the particular operation and also for the details concerned with anesthesia.

A complete operative outline is presented for reduction of the nasal hump, including the successive steps for removing the hump, narrowing the bridge, shortening the septum, and remolding the nasal tip. Postoperative measures are also outlined. Many minor corrections are considered, such as those concerned with the columella and the nostrils and various procedures for widening or narrowing any part of the nose. Methods for straightening the nose which is deformed or deviated from any cause are fully indicated, as are also the methods of repairing cleft lip in its various aspects. A number of corrective operations on the nose in infancy and childhood are illustrated. This material creates the impression that the authors are not among those who believe in the desirability of delaying such corrections until nasal growth is complete. The section on the means of restoration in extensive destruction of the nose and face is of particular present value. The choice of bone transplants and of skin grafts is dealt with quite fully. Both benign and malignant tumors are considered with respect to surgical treatment as well as the preparation and fitting of prostheses.

The lack of customary literary references, except to papers prepared by the writers and their associates, is notable. The authors account for this lack in the prefatory statement that "it seems impossible to assign proper priority for every operation and all of its variations. . . ." Chief credit is given to the original work of Joseph (Joseph, J.: "Nasenplastik und sonstige Gesichtsplastik," 1931), who has been called the father of plastic surgery.

The 379 photographs, of which 48 are in color, are deserving of special mention, since by their excellence they serve to clarify the text by visual image.

This comprehensive presentation of methods for nasoplastic surgery is a worthy addition to the present literature on this subject and will be found to be of especial value to the inexperienced operator.

Directory of Otolaryngological Societies *

INTERNATIONAL

Pan American Association of Oto-Rhino-Laryngology and Broncho-Esophagology

Meeting: Fourth Pan-American Congress of Oto-Rhino-Laryngology and Broncho-Esophagology.
Place: México, D. F., Mexico, Time: January, 1954.
President: Dr. Justo Alonso.
Exec. Secretary: Dr. Chevalier Jackson, 1901 Walnut St., Philadelphia 3, Pa.
President of Congress: Dr. Ricardo Tapia Acuna.

Third Latin-American Congress of Otorhinolaryngology and Bronchoesophagology

Place: Caracas, Venezuela. Time: 1953.

Fifth International Congress of Oto-Rhino-Laryngology

Place: Amsterdam, Netherlands. Time: June 8-15, 1953.
President: Prof. Eelco Huizinga.
General Secretary: W. H. Struben, J. J. Viottastraat 1, Amsterdam-Z.
Scientific Secretaries: J. Bijtel and P. G. Gerlings.

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. Carl H. McCaskey, 20 N. Meridian St., Indianapolis.
Secretary: Dr. Sam H. Sanders, 1089 Madison Ave., Memphis 3.
Place: Chicago. Time: June 11-13, 1952.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Derrick Vail, 700 N. Michigan Avenue, Chicago 11.
Executive Secretary-Treasurer: Dr. William L. Benedict, 100-1st Ave. Bldg., Rochester, Minn.
Place: Palmer House, Chicago.

American Board of Otolaryngology

Secretary: Dr. Dean M. Lierle, University Hospitals, Iowa City.
Place: Palmer House, Chicago. Time: Oct. 6-10, 1952.
Place: Royal York Hotel, Toronto, Canada.

American Broncho-Esophagological Association

President: Dr. Herman J. Moersch, Mayo Clinic, Rochester, Minn.
Secretary: Dr. Edwin N. Broyles, 1100 N. Charles St., Baltimore 1.
Place: Royal York Hotel, Toronto, Canada.

American Laryngological Association

President: Dr. H. Marshall Taylor, 111 W. Adams St., Jacksonville, Fla.
Secretary: Dr. Louis H. Clerf, 128 S. 10th St., Philadelphia 7.
Place: Royal York Hotel, Toronto, Canada.

American Laryngological, Rhinological and Otological Society, Inc.

President: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester 7, N. Y.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester 7, N. Y.
Place: Royal York Hotel, Toronto, Canada.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.

SECTIONS:

Eastern.—Chairman: Dr. Francis W. Davison, Geisinger Memorial Hospital, Danville, Pa.
Place: Waldorf-Astoria, New York.
Southern.—Chairman: Dr. Lester A. Brown, 490 Peachtree St., Atlanta.
Place: Academy of Medicine, Atlanta.
Middle.—Chairman: Dr. Ralph J. McQuiston, 20 N. Meridian St., Indianapolis.
Place: Indianapolis Athletic Club, Indianapolis.
Western.—Chairman: Dr. Howard P. House, 1136 W. 6th St., Los Angeles.
Place: County Medical Building, Los Angeles.

American Otological Society

President: Dr. Gordon D. Hoople, 1100 E. Genesee St., Syracuse, N. Y.
Secretary: Dr. John R. Lindsay, 950 E. 59th St., Chicago.
Place: Royal York Hotel, Toronto, Canada.

American Otorhinologic Society for the Advancement of Plastic and Reconstructive Surgery, Inc.

President: Dr. Benjamin H. Shuster, 1824 Pine St., Philadelphia.
Secretary: Dr. Joseph G. Gilbert, 111 E. 61st St., New York 21.

American Society of Ophthalmologic and Otolaryngologic Allergy

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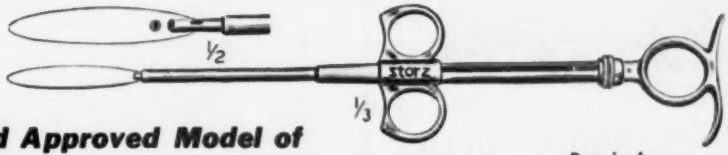

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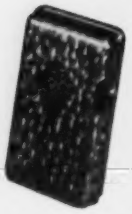

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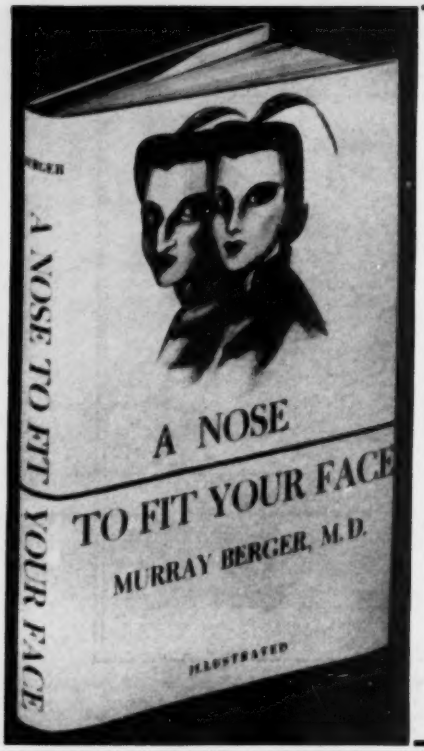

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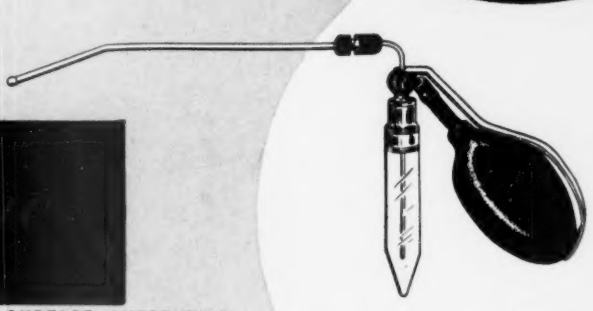

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